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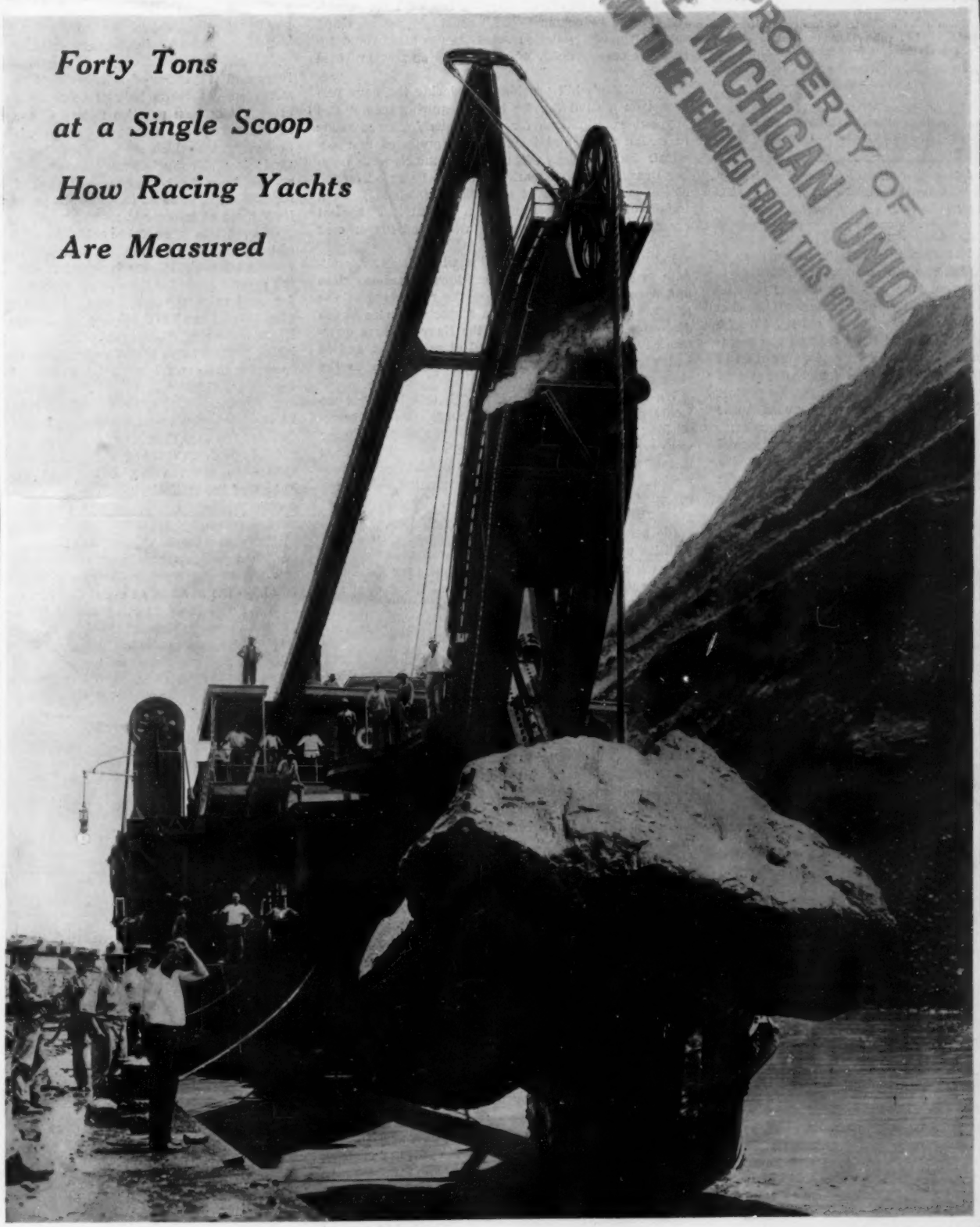
Are Measured



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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Cape Cod Canal in Service

WHEN Nature shaped out the promontory of Cape Cod, she did so in such fashion as to suggest, from the very first days of colonial occupation, the advisability of circumventing that serious obstacle to safe navigation by cutting through the narrow neck which joins Cape Cod to the mainland. For it is a fact that the first serious mention of canal cutting dates from early colonial days; and in the intervening centuries, at intervals, the project has received the serious attention of the engineer, the shipping man, and the State and Federal authorities.

The perils of Martha's Vineyard, Nantucket Sound and the western shore of Cape Cod, have constituted a serious menace to the ever-increasing coastwise traffic between the southern and northern ports of the Atlantic seaboard. Shipping that has worked its way to the eastward under the friendly shelter of Long Island, and in the comparatively smooth waters of Long Island Sound, has been confronted by the fog and heavy currents of Nantucket Sound, and by the danger of being caught by Atlantic gales upon the harborless stretch of a lee shore on Cape Cod. That the perils of this part of the coastwise passage have been very real is proved by the estimate of shipping men that, during the last three quarters of a century, over 2,000 ships and about 700 lives have been lost in the perilous passage around the Cape.

The opening of the Cape Cod Canal on July 29th has changed all this; and the security which will be afforded by the new waterway and the reduction in the cost of transportation, can be appreciated only by those shipping men and mariners who have been familiar with the cost and risks of the old outside passage.

Cape Cod Canal has been cut through an eight-mile strip of land which intervened between Barnstable Bay and Buzzards Bay. The interests which have now completed the work, in 1899 took up the task where it had been abandoned by previous companies. The building of the canal has presented no engineering problem of difficulty, and the work has consisted of straightforward excavation through sand, interspersed in certain portions of the route with boulders. The work has been done at sea level, and it has involved the removal of about 20,000,000 cubic yards of sand and earth. The highest point cut through had an elevation of only 29 feet, and the work was facilitated by the fact that much of the work lay below sea level. Although the canal is only eight miles in length from entrance to entrance on the shore line, it continues with a 30-foot depth in Buzzards Bay and Barnstable Bay by extensions which makes the actual length of the channel twelve and one half miles. The minimum width at the bottom is 100 feet and at the surface 250 feet.

The commercial utility of the canal will be appreciated, when it is stated that the average delay per round trip yearly for barges and schooners over the outside route is nearly four days, which is equivalent to a loss of 10 cents per ton on the 7,000,000 tons of coal and lumber carried in these craft alone. Add to this that the total amount of coal and lumber carried by steamers is 4,500,000, on which an equal saving per ton will be realized, and it will be seen that, in spite of its short length, this canal will carry in its first year of operation an amount of tonnage equal to, if not greater than, that which it is estimated will seek the Panama Canal in the first year of service of that great work.

Navy Personnel Legislation

FOLLOWING the statement of Rear Admiral Knight, a member of the 1914 Plucking Board, that the recent "pluckings" of five captains from the naval service has added not one iota to the efficiency of the navy, and that these men were plucked because of an act of Congress which forced this unwelcome duty upon the pluckers, Congressman Fred A. Britten, a member of the Committee on Naval Affairs, recently introduced in the House a bill providing for the total elimination of the Plucking Board and the retirement of naval officers by themselves through a series of examinations.

In speaking of his bill, the Congressman said that the great criticism heaped upon the last Plucking Board for retiring such able officers as Captains Hill and Gibbons, who in themselves are the equal in efficiency to most rear admirals still in the service, is but another evidence of why the law of 1899, providing for the "Plucking Board," should be repealed and some form of legislation substituted which would insure the same number of retirements as now provided by law.

Mr. Britten's bill provides for placing the navy personnel on a Civil Service basis, requiring mental and physical examinations for promotions from the grade of ensign up to and including the grade of rear admiral. Examinations will be held by the Navy Examining Board, and final markings are to be based on the official service record of the officer, which is given a weight of 60 per cent, and on a mental and physical examination, which is given a weight of 40 per cent out of a total of 100.

Failure to pass an examination will cause the candidate to be registered in the next lowest academy class and a second failure will cause the retirement of the officer, who may be retained in a special service at the discretion of the Secretary of the Navy at three quarters pay of the rank he occupied at retirement, and in which service he may advance by promotion to the rank of commander.

We are in hearty sympathy with this bill; but we would suggest that it would be more sure of accomplishing its purpose, if the markings and percentages were rearranged so as to include a vote by the officers themselves on the efficiency of the candidates for promotion. This suggestion, which originated among the personnel, contemplates having the officers of each grade pass upon the efficiency of the candidates in the grade below. The intimate knowledge of each others' abilities which obtains among naval officers would render such estimates of great value; and they should be incorporated in the official record and the mental and physical markings, as proposed by this bill.

The Kaleidoscopic Plans of an Exploring Expedition

IN September, 1913, it was announced from England that Mr. J. Foster Stackhouse was organizing an expedition for the purpose of exploring King Edward VII Land, in the Antarctic. This announcement came at an auspicious moment, as the enthusiasm which it evoked was, in part, a *contre-coup* to the painful impression produced by the then recent disaster to the Scott expedition. The promoter of the new enterprise made rather free use of Scott's name in connection with his undertaking, announcing that Scott had approved its plans, and pointing out that the exploration of King Edward VII Land had been an unfulfilled part of the programme of the British Antarctic Expedition of 1910-13. His effort to establish a connection between his expedition and Scott's was, however, repudiated by Commanders Pennell, Evans and Campbell, and other members of the expedition of 1910-13.

In the course of a few weeks the plans of the expedition underwent considerable alteration. Early in November it was stated that the explorers would not sail directly to King Edward VII Land, but would first explore the coast between this region and Graham Land, beginning at the latter. Further announcements indicated that the exploration of this unknown coastline had become the principal purpose of the expedition. In February of this year a detailed programme was announced, including the landing of a party on the east side of Graham Land, and three years of cruising and exploration along the coast as far west as McMurdo Sound; but apparently no exploring in the interior of King Edward VII Land. Last April the sailing date of the expedition was postponed to the end of the present year or the beginning of next.

A few weeks ago press dispatches brought the surprising information that Mr. Stackhouse and his party expected to sail in December, 1914, not for the Antarctic, but for Iceland, and to spend seven years in miscellaneous oceanographical research more or less all over the world. The enterprise, it appears, is now known as the British Antarctic and Oceanographical Expedition, but Antarctic exploration occupies only a minor place in the programme. According to a circular letter issued by the leader, the expedition proposes (1) to investigate reports of mariners as to the existence of dangerous uncharted rocks, shoals, reefs, islands, etc., on the trade routes of the world; (2) to discover the extent and position of the coast line still left unmapped on the continent of Antarctica; and (3) to make a scientific survey of the sea in general.

Finally, the New York *Times* of July 26th informs us that "Commander" Stackhouse has accepted an important post in connection with the arrangements for next year's proposed aeroplane race around the world, and will undertake the laying of caches and the erection of landmarks on the coast of Greenland for the benefit of the contestants. From all of which it appears that the gentleman in question is exceedingly anxious to quit the shores of Albion, but is not at all particular about his destination.

Observations on Finishing Temperatures and Properties of Rails

THE main objects of the investigation recently completed by the Bureau of Standards, Department of Commerce, into the finishing temperatures and properties of rails were to determine, from measurements taken in representative rail mills, the present American practice regarding the temperatures at which rails are rolled; to demonstrate the ease and accuracy with which such temperatures may be measured; to find out what the "shrinkage clause" in rail specifications really means; and finally, to determine for rail steels some of the physical properties, particularly those of interest in manufacture.

Observations were taken with an optical pyrometer of ingot and finishing temperatures of rails in four representative mills. There is practical uniformity among the several mills for the rolling temperatures of ingots for steel rails, the range being from 1,080 deg. Cent. (1,975 deg. Fahr.) to 1,140 deg. Cent. (2,085 deg Fahr.). There is no very considerable difference among the finishing temperatures of the rails as observed at the hot saws for the several mills, the range being about 880 deg. Cent. (1,615 deg. Fahr.) to 990 deg. Cent. (1,815 deg. Fahr.). Or, in other words, the four mills all finished their rails to within 50 deg. Cent. of 935 deg. Cent. (1,715 deg. Fahr.) on the average. This temperature of 935 deg. Cent. is 270 deg. Cent. (520 deg. Fahr.) above the mean value, 665 deg. Cent. (1,230 deg. Fahr.) of the critical ranges of these rail steels. Concerning the distribution of temperatures within the head of a cooling rail, it is shown that the center of the head is some 50 deg. Cent. (120 deg. Fahr.) to 60 deg. Cent. hotter than the optical pyrometer reading at 935 deg. Cent., therefore the center of the head is finished, on the average, at about 325 deg. Cent. (615 deg. Fahr.) above the critical range for 100-pound sections.

The following thermal properties of sample rail steels were determined in the laboratory:

The critical range or heating is located (maximum) to within 70 deg. Cent. of 732 deg. Cent. (1,350 deg. Fahr.) for the ten samples of Open Hearth and Bessemer steels examined. On cooling the critical range lies between the limits 680 deg. Cent. (1,256 deg. Fahr.) and 650 deg. Cent. (1,202 deg. Fahr.).

The melting or freezing range for rail steel extends from about 1,470 deg. Cent. (2,680 deg. Fahr.) to nearly the melting point of iron, located at 1,530 deg. Cent. (2,786 deg. Fahr.).

The expansion of Open Hearth and Bessemer steels is not the same. Above 800 deg. Cent. (1,470 deg. Fahr.) the expansion for both increases linearly with temperature and the linear coefficient per degree Centigrade has the following mean values between 0 deg. and 1,000 deg. Cent.:

(1) For Bessemer steel (carbon 0.40 to 0.50 per cent): alpha = 0.0000146.

(2) For Open Hearth steel (carbon 0.65 to 0.70 per cent): alpha = 0.0000156 to 0.0000161.

The average composition of the Bessemers was carbon = 0.40 to 0.50 and manganese = 0.76 to 0.93; of the open hearth, carbon = 0.66 to 0.70 and manganese = 0.66 to 0.72.

The American Society for Testing Materials in 1909 limited the shrinkage allowance on 100-pound sections to 6¾ inches in 33 feet, or to an equivalent of 1,947 deg. Fahr. (1,064 deg. Cent.) for Open Hearth, and 2,055 deg. Fahr. (1,134 deg. Cent.) for Bessemer rails. This specification is still in force. Such a shrinkage clause, therefore, does not serve the avowed purpose of limiting the finishing temperatures to a value slightly above the critical range.

In conclusion, it should be emphasized that the various series of observations recorded in this investigation are of but a preliminary nature and do not pretend to solve the question of the relations between temperature of rolling and the properties of rails. It would seem desirable to make a much more complete and comprehensive study of the various matters mentioned and of related questions than has hitherto been attempted, and on a scale commensurate with the importance to the community of the problem of sound rails.

Engineering

Battleships as Targets.—The Navy Department is considering the question of using our obsolete battleships of the time of the Cuban War as targets for big-gun practice. The results obtained by the navy for some years past in shooting at the old Texas have been so valuable that it is realized the data obtained from firing at the Iowa, Massachusetts or Indiana, would be of far more value to the Navy than any sum that could be realized from the sale of these vessels as junk.

Driving the Longest Tunnel in America.—At present the longest tunnel in America is the Hoosac tunnel, at North Adams, Mass., which is four and three quarters miles in length; but there is now being constructed on the Rocky Mountain Division of the Canadian Pacific Railroad, what is known as the Roger Pass Tunnel, which will be five miles in length. It will cost over $10,000,000. The highest point reached by the tunnel will be 3,795 feet above sea level, or 4,065 feet below the extreme top of the mountain. The tunnel will have a rising grade of one per cent to its interior summit.

Zinc Ore Plant in North Africa.—The use of hydraulic power in Kahylia is quite rare, so that we may cite the new plant for the use of the Gergur zinc mines which lie about 60 miles from the coast. In order to secure power for operating electric motors at the ore-washing plant, the engineers decided to erect a hydraulic plant at Kef-el-Afsa, where the bed of the Bon Sellam runs between rock walls and a barrage could be readily built across the gorge. This backs up a lake of some miles length. The electric station lies adjacent to the barrage, and contains a Francis turbine coupled to a 150 horse-power alternator of 3-phase 3,000 volt type. A power line takes current for a few miles to the zinc plant.

Large Egyptian Pumping Plant.—One of the largest pumping installations in the world is being built by the Egyptian government to drain Lake Mareotis, near Alexandria. It will consist of eighteen enormous pumps of the Humphrey type, which has already been described in the SCIENTIFIC AMERICAN. Each pump is 8 feet 8 inches in diameter, and is capable of delivering 100,000,000 gallons per day through a lift of twenty feet. The maximum internal diameter of the combustion chamber will be 8 feet 8 inches, and its height 14 feet. The water valve box will be 8 feet 8 inches in diameter and 7 feet high, and it will be fitted with 100 valves of the hinge type, specially designed to enable any valve to close upon an obstruction, without throwing undue strain on the hinges.

Mosaics upon Reinforced Concrete.—At an earlier time, reinforced concrete was made to imitate stone construction to a large extent, but at a later stage architects commenced to use forms which were adapted to the nature of the material, which is of course only logical. The same applies to the question of ornament upon reinforced concrete, and while molded relief can be very well used, it is found that the flat surfaces are also well adapted to receive colored tile decoration, with very good effect. More recently, a mosaic decoration is coming into use, for the concrete most naturally lends itself to imbedding of mosaic directly in the material, and this can be done with very little trouble. This method is beginning to be employed in France for house trimmings, and the bright colors of the mosaics add considerably to the otherwise rather dull hue of the cement.

Protecting Oil Tanks Against Fire.—There was recently tested satisfactorily at the Standard Oil Works in Bayonne, New Jersey, a device for automatic extinguishing of fire. The tank of 50,000 gallons capacity was nearly filled with water, on the surface of which was a layer of Mexican crude oil, five inches deep. Above this two buckets of gasoline were suspended to assist ignition. From the time the oil was fully ablaze until the time of extinction of the fire, was only nine seconds. The principle consists in producing large volumes of carbon dioxide by the automatic mixing of the proper ingredients, which are contained in four upright tubes attached to the tank. The contents of the tubes are held in position by fusible wires, which, when the temperature reaches a certain point, are fused, permitting the constituent substances in the tubes to mingle and produce large volumes of the carbon dioxide.

Last Year's Gunnery and Engineering Work.—The Secretary of the Navy has sent letters of commendation to the officers who commanded the vessels which won the gunnery and engineering trophies for the last year. These were as follows: Capt. J. H. Glennon, U. S. S. "Wyoming," gunnery trophy in the battleship class; Capt. W. B. Fletcher, U. S. S. "Kansas," winner of the battleship engineering trophy; Lieut.-Commander Arthur Crenshaw, U. S. S. "Cummings," battle-efficiency pennant in the torpedo boat destroyer class; Lieut.-Commander W. N. Jeffers, U. S. S. "Fanning," gunnery trophy destroyer class; Lieut.-Commander C. P. Hutchins, U. S. S. "Beale," engineering trophy, destroyer class; Commander R. H. Leigh, U. S. S. "Galveston," gunnery trophy, cruiser class; Commander J. K. Robinson, U. S. S. "Dixie," gunnery trophy, gunboat class; Lieut. Luther Welch, U. S. S. "F-3," winner of gunnery trophy in the submarine class.

Science

A Geological Manual for Exposition Visitors.—For the benefit of visitors to the Panama Exposition at San Francisco, the U. S. Geological Survey is preparing to publish a bulletin on the geology and other physiographic features of a strip of land about 25 miles wide along the Santa Fé Railway from Kansas City to Los Angeles. It will include geological and topographic maps on a scale of 1:500,000, while the text will give an account of notable scenic features, Indians, history, and local industries.

An Index to Seismological Literature.—During the period of 1841–1912, the British Association published 53 annual reports and other notices about seismology and other branches of geophysics, constituting, in the aggregate, an immense body of varied and valuable information. In order to make all this material easy of access, the late Prof. Milne prepared a subject-index to it, and included in the same index references to a number of notes and papers in the "Transactions of the Seismological Society of Japan" and the *Seismological Journal*. This index is published in the Report of the British Association for 1913, just issued.

Biological Tests of Honey are described by J. Thöni in the *Schweizerische Bienen-Zeitung*. Such tests are necessary for detecting artificial or adulterated honey, when the natural product is almost perfectly imitated as to its physical and chemical properties. Two tests are described in detail, viz., the diastase reaction, based on the fact that honey contains a diastatic ferment secreted by the bee, which, in contact with soluble starch, is capable of transforming the latter into sugar; and the precipitin reaction, based on the fact that honey contains a special protein secreted by the bee, which, when inoculated into rabbits, causes the formation of antibodies in the blood serum; these antibodies, when mixed with the honey under examination, yield a precipitate, and the quantity of this precipitate indicates the kind and amount of the adulteration.

Lead Derived from Radium.—A very interesting paper by K. Fajans on the different atomic weights of lead was read before the Bunsen Gesellschaft für angewandte physikalische Chemie at Leipzig. According to a line of reasoning, simultaneously developed by Fajans and Soddy during the last few years, lead derived from radium and lead derived from thorium by the loss of five and six atoms of helium respectively should be identical, except in atomic weight. Throughout the past year, Dr. Fajans' assistant, Dr. Lembert, has been working in Richard's laboratory at Harvard, in order to obtain atomic weights of as high a degree of trustworthiness as possible. The differences established by the series of determinations announced at the meeting by Fajans amount to about 0.3 per cent. In this connection, it is interesting to note that Soddy and Hymans read a paper before the London Chemical Society on May 7th, in which they likewise described experiments which showed a difference between thorite lead and ordinary lead of 0.5 per cent.

A Tabloid Course in Forestry is offered this year, for the second time, by the New York College of Forestry at Syracuse, in the shape of a summer forest camp in the Adirondacks during the month of August. The purpose of the camp is two-fold, viz., to give such elementary training in forestry as will indicate in a way to prospective forestry students just what the practice of forestry means; and to give men who love an out-of-door life an opportunity to learn something about the forest, its trees, shrubs, and animal inhabitants. The camp is located this year on Hoel Pond, just north of Upper Saranac Lake, and is open to youths and men of over 15 years of age, who are in good physical condition. There are from two to five instructors constantly in camp. A course of daily lectures on plant relationships, with field trips; a ten day course on forest zoology; a week's course on the fungi of the forest; and a week's course in wooderaft by a veteran Adirondack guide are on the programme for this summer.

A Japanese Scientific Journal.—There is an interesting review in *Nature* of the March issue of *Gendai no Kagaku (Scientific Gazette)*—a new Japanese journal similar to *Nature*, printed in Japanese characters. It has been designed to meet an increasingly felt need for a serious and authoritative general organ for the growing body of men of science and students of research in Japan. The journal is well printed, and its contents are written and edited by professors of the Tokyo and Kyoto Imperial Universities. The issue in question contains special articles on insects and their pupæ, the relation between zoology and medicine, great men of science, and inertia and relativity; reviews of books; notes and abstracts classified under the various sections of astronomy, physical geography, biology, chemistry, and applied sciences; meteorological reports and ephemerides of celestial phenomena, and proceedings of societies. In the last named section no fewer than eight learned societies of Tokyo are represented. The illustrations include a collotype portrait of Prof. Simon Newcomb, and a star chart, to be continued serially. The publication is to be welcomed as a sign of the increase of interest in scientific subjects in Japan.

Automobile

Turning the Head-light from the Steering Gear.—A head-light which may be coupled with the steering mechanism so it will be automatically shifted with the movements of the front wheel of the automobile is shown in patent No. 1,100,946, to John J. Bjoblie, Pekin, N. D.

Regulating and Recording Automobile Speed.—In a patent, No. 1,100,254, Abel Raimond Alexandre Gerard de Recondo, Paris, France, presents an apparatus to regulate the speed of motor cars and to record the excess of speed in case the determined speed is exceeded.

An Automobile Tire Pump Driven from Air Pump.—Charles N. Colstad, of Atlantic, Mass., in a patent, No. 1,100,056, drives the tire pump from the fan-driving mechanism, the tire pump being associated with the fan-supporting bracket.

Road Mirrors for Motorists, placed at dangerous turns or junctions of streets and roads, have found their way to India. The American consul at Bombay reports that the largest of these devices heretofore installed anywhere in the world is to be placed at a street corner in that city. Its size will be 10 feet by 5, as contrasted with 2½ by 3 feet, the customary size in England.

A Powerful Portable Wireless Outfit.—The Signal Corps of the United States Army has just taken delivery of what is probably the most powerful portable wireless telegraphy outfit of its kind. The apparatus is mounted on a motor car chassis and can be set up complete and in operating condition in as short a time as 12 minutes. Under favorable conditions, the apparatus has a sending radius of up to 800 miles. Messages from points 2,500 miles distant have been received. The generator which furnishes the current is driven by the same motor that propels the vehicle. Antennæ of the umbrella type are used, the mast, which is in nine sections, being 85 feet in height.

An Omnibus Company's Interpreters.—The proprietors of the London General Omnibus Company, which operates the majority of the 'buses that ply the streets of London, have taken a novel means to increase the number of passengers carried. A dozen men speaking several languages will be stationed at as many busy centers so that foreigners may have no difficulty in choosing a 'bus for their proper destination. Already the company has established a school where the men are trained. They will be taught French, German, Russian, Danish, Spanish, Norwegian, Polish and Arabic, will wear a special uniform and display a badge, making plain the languages they are prepared to give information in.

Synthetic Motor Fuel Possibilities.—The synthetic production of gasoline, or rather motor fuel, is not unknown, though heretofore its production has been little more than a laboratory experiment. A few weeks ago, however, a Portuguese-American chemist claims to have succeeded in producing a quantity of motor fuel which was tested on the Indianapolis Speedway with good results. The inventor uses naphthaline, the white powder of which moth balls are made, and water, in combination with another ingredient, the name of which has not been divulged. The three are run through an ordinary still. The liquid produced closely resembles gasoline and has a Baumé test of 64 degrees. A large six-cylinder car ran 12.5 miles on one gallon of the fuel. With gasoline, the same car ran 17.5 miles an hour. The inventor claims that the new fuel can be produced in commercial quantities cheaply.

Block Testing of Motors with City Gas.—The cost of gasoline is comparatively high, and, by way of reducing factory overhead, a number of Detroit makers lately have taken to testing their motors with city gas instead of with gasoline. It has been found that an economy of as much as $80 a day can be effected by some makers. It has been found that the city gas at 45 cents per 1,000 feet is cheaper for the purpose than gasoline at 9 cents a gallon. A comparison of costs reveals that an engine developing 19.04 horse-power consumes 458 feet of gas which costs 20.61 cents an hour; while 2.24 gallons of gasoline would be required to develop the same power, and the cost would be 33.6 cents an hour with gasoline costing 15 cents a gallon. On one test, it was proven that the cost of city gas works out at 58 per cent of the cost of gasoline.

Carbon Deposit and the Sleeve-Valve Motor.—Far from being detrimental to the operation of the sleeve-valve motor, carbon, according to the statement of Chas. Y. Knight himself, actually is of benefit. Knight explains this seeming incongruity by stating that the carbon deposit assists in closing minute interstices in sleeves and walls, and thereby prevents leaks and helps maintain the compression pressure. Furthermore, he sounds a note of warning regarding the indiscriminate removal of carbon deposits from Knight motors and states that sharp-edged tools should not be used for the purpose. Instead, he advocates the use of rough fabric which will carry away such loose particles as might cause pre-ignition and leave the heavier deposit with its glossy surface in place. He attributes the formation of carbon rather to the poor quality of fuel and to its incomplete combustion than to road dust and the burning of lubricating oil.

Commandant Barres and Lawrence Sperry at the conclusion of a flight.

The Sperry Gyroscopic Stabilizer

How It is Constructed, How It Operates, and How It Demonstrated Its Capabilities During an Interesting Test in France

By John Jay Ide, Paris Aeronautic Correspondent of the Scientific American

Test of Sperry stabilizer, Bezons, June 18th, 1914.
Pilot standing up in seat and passenger 6 feet out on right plane.

A DESCRIPTION of the Sperry stabilizer for aeroplanes was given in the SCIENTIFIC AMERICAN for June 7th, 1913. Although the principle of operation remains the same, a number of changes in the construction have been made since that date. The stabilizer is now fitted to a Curtiss flying-boat instead of to the old type hydro-aeroplane of the same make.

The apparatus proper consists of a group of four gyroscopes arranged in two pairs. The gyroscopes forming a pair revolve in opposite directions in order to neutralize precessional movement. One pair turns in the plane of symmetry of the aeroplane, and the other in the vertical plane parallel to the span. The group is contained in a sort of cage composed of two rings, one horizontal and the other vertical. The cage being universally jointed can oscillate around its lateral and longitudinal axes. Attached to the rings are levers acting on the valves of two compressed air servo-motors, placed near the gyroscopes, controlling the elevator and ailerons. In normal flight the gyroscopes keep the axes of the rings strictly horizontal and vertical so that the slightest tipping of the aeroplane in any direction is instantly corrected through the servo-motors.

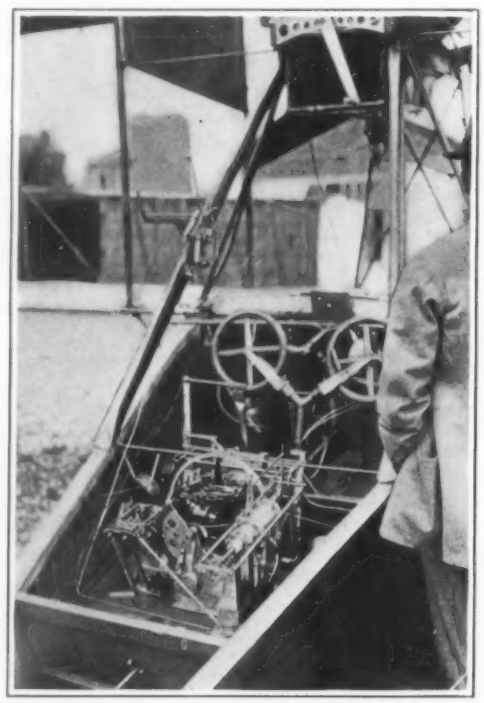
An essential part of the Sperry apparatus is the anemometer mounted on the right forward engine strut. As Mr. Skerrett states in the article referred to above, the anemometer accomplishes three functions. In the first place it furnishes the pilot with a visible record of his speed at any moment. Secondly, it prevents the machine from rising so steeply that there is danger of its falling back on its tail. When the aeroplane approaches the critical angle, the loss of wind pressure on the rectangular disk causes the anemometer, by means of the servo-motor, to block the longitudinal control lever as regards further climbing by shifting its fulcrum. The aeroplane is then automatically started on a gliding descent which is continued until the normal flying speed is regained.

Finally, the anemometer regulates the action of the gyroscopes in turning. A certain angle of the aeroplane relative to the plane of the gyroscopes entails a corresponding opening of the valve of the servo-motor, and consequently a corresponding angle of the ailerons or elevators as the case may be. As this angle depends upon the inclination of the aeroplane and not on its speed, the effect would vary greatly according to the velocity of the machine. A certain angle which would be suitable for low speeds would be much too great if the speed were high, and might even throw the pilot out of his seat. The anemometer by changing the fulcrums of the levers controlling the valves of the servo-motors according to the wind pressure on its face insures that the corrective efforts of the ailerons and elevators are proportionate to the speed.

The electricity necessary for the gyroscopes, which weigh only two pounds each and turn at 12,000 revolutions per minute, is obtained from an alternating current dynamo run from the front end of the motor by a belt. It is claimed that in case of stoppage of the motor the gyroscopes would continue revolving for half an hour. A battery, however, is carried as a reserve. A regulator, seen in one of the photographs in front and to the left of the apparatus, controls the current used by the gyroscopes. As the current is alternating, a wireless installation can be fitted with very little extra weight.

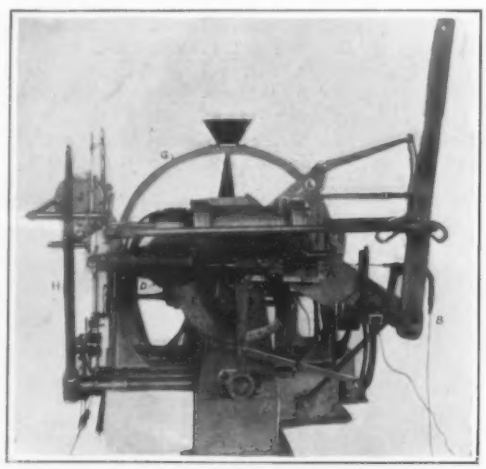
Compressed air is obtained from the motor and stored in a tank in a similar manner to that employed in compressed air self-starters for automobiles. The tank is of sufficent capacity to supply the servo-motors for a short period after the stoppage of the engine. To get up pressure, however, the motor has to be run for a short period before a flight and leakage is impossible to obviate entirely. In the stabilizers now under construction electric servo-motors are employed. The total weight of the apparatus is about 45 pounds.

Both lateral and longitudinal controls can be thrown in and out of action at the will of the pilot by means of a pedal. When the stabilizer is in action the ordinary means of control are completely blocked, but the direction of the machine can be changed laterally or longitudinally by small supplementary levers.



Front view of Sperry stabilizer.

Showing servo-motor at right and rear of gyroscopic group; regulator in front to the left; anemometer above attached to engine strut.



Rear view of Sperry stabilizer.

A, automatic lateral lever pivoted on valve control crank; *B*, wire leading to supplementary control lever; *C*, control lever (lateral); *D*, gyroscope; *E*, inclinometer; *F*, cylinder of servo-motor; *G*, suspension ring; *H*, control lever (longitudinal); *J*, longitudinal control cylinder.

On Thursday, June 18th, at Bezons, near Paris, I saw the first demonstration before the committee of the Concours pour la Securité en Aéroplane. During the flights Lawrence Sperry, the pilot, stood up with his hands above his head, abandoning all controls, while the mechanic left his seat and climbed out on the right wing, 6 feet from the longitudinal axis of the machine. As the passenger weighed 170 pounds, the upsetting moment was 1,020 foot-pounds. The first time this was done the aeroplane described a wide turn to the right owing to the extra head resistance, but on the second trial the machine kept its course perfectly, the pilot having set the rudder to the left before abandoning control. In neither case was the stability of the machine affected in the slightest degree, the ailerons automatically changing their angle of incidence so as to keep the aeroplane on an even keel.

Later the mechanic climbed back to the trailing edge of the plane, and this time the elevators corrected the upsetting moment. By reducing the speed of the motor the flights were terminated with automatic glides down to the surface of the Seine. After these flights Sperry took up Commandant Barres and Lieutenant Caylo successively to observe that he did not touch the control levers when the stabilizer was in operation.

The committee was so interested that they asked for a second series of tests, which took place the following Tuesday. On this occasion Réné Quinton, the president of the Ligue Nationale Aérienne, was carried as a passenger for half an hour. Although a high wind was blowing at the time, the aeroplane was entirely unaffected, thanks to the stabilizer. The tests indeed were so successful that the committee of the Concours has awarded first prize, 50,000 francs, to the Sperry automatic stability device. The grand prix, 400,000 francs, has not been won this year.

The Mont Blanc Observatories

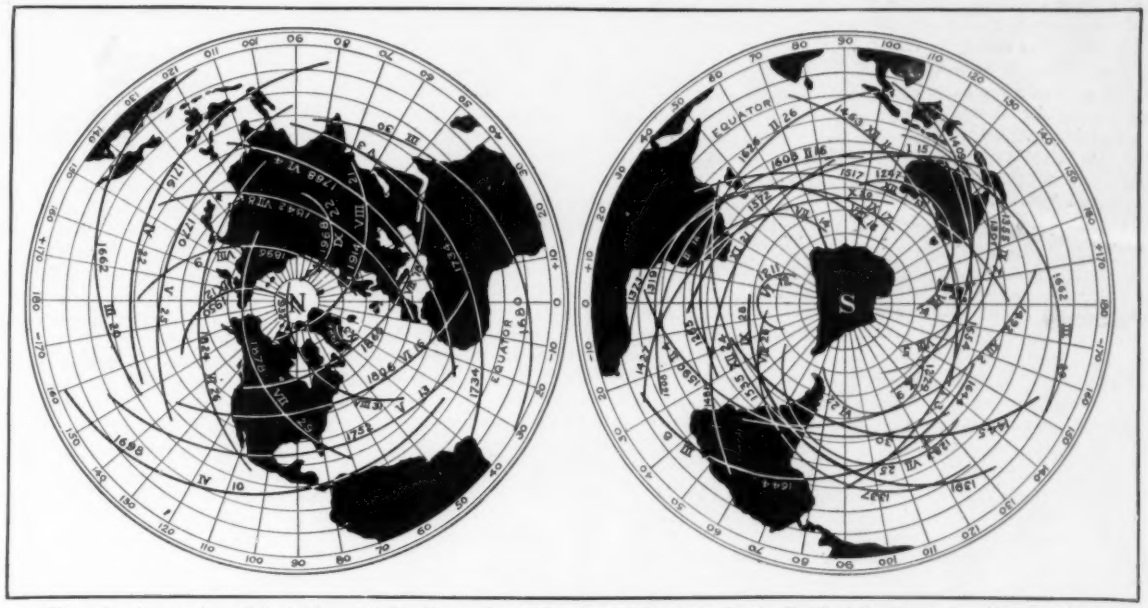
OF the two famous observatories that have existed on Mont Blanc, that constructed on the very summit by Janssen, in 1893, no longer stands. It was built entirely on the snow and ice, as borings to a depth of 70 feet failed to find rock. A few years ago this building tilted over and gradually sank into a fissure, supposed to have been caused by an earthquake. Its turret is now preserved in the Alpine Museum at Chamonix, while the rest of the building was mostly used up as firewood at the neighboring Vallot Observatory. The question of building another observatory on the summit is now under consideration. During the present summer a commission consisting of the astronomers Hamy, Puiseux and Stefanick, the veteran Alpinist, Vallot, and the physiologist, Dr. Bayeux, are to ascend the mountain and investigate the possibility of carrying out this project. The Vallot meteorological observatory, which is not on the summit, but on the Rocher des Bosses, was constructed in the summer of 1898, on the site of a still earlier observatory, dating from 1890. It is a small one-story structure of wood, sheathed in copper, containing two laboratories, a dining-room, a kitchen, and a workshop, and accommodates seven people. M. Vallot, who has made upward of thirty-six ascents of Mont Blanc, usually spends the month of August at his observatory, with a few scientific colleagues as his guests. The observatory is not, like that on Monte Rosa, connected with the world by telephone, but optical signals are exchanged with Chamonix.

In preparation for the coming fire season in California, 110 miles of fire line have been built in the Sierra national forest.

Graphic Prediction of Solar Eclipses

By Samuel W. Balch

THE method of predicting an eclipse is for most people much of a mystery, and, in its ultimate refinements, must so remain, but there are some rough methods which are easy to understand, and which were probably used in ancient times. If a careful record be kept of eclipses observed all over the earth, it will be found that while they follow each other in a seemingly erratic manner, sometimes a month, and sometimes five or six months apart, the programme is very nearly repeated at intervals of 18 years, 10 or 11 days, 8 hours. The variation of an even day is because sometimes four leap years and sometimes five leap years fall within the period. The actual length is always very nearly 6,585⅓ days. This period is known as the Saros and was discovered by the ancient Babylonians. Eclipses depend chiefly on three celestial revolutions; *a*, the revolution of the earth around the sun; *b*, the revolution of the moon around the earth; *c*, the revolution of the line of nodes. The plane of the moon's orbit is inclined five degrees to the plane of the earth's orbit and the line of intersection of the two planes is the line of nodes. In the Saros period there are 241 revolutions of the moon with respect to the stars, or exactly 223 revolutions with respect to the sun. There is also one revolution of the line of nodes with respect to the stars, or 19 revolutions with respect to the sun in the Saros period. The revolution of the line of nodes fits the period with an error of one half of a degree, but the shadow will strike the earth when the moon is within eleven degrees either way from the node at conjunction, so that forty-four recurrences will fall within the span of twenty-two degrees. The years contained in the Saros also being close to a whole number, it follows that this period brings the earth, sun, and moon back to very nearly the same position. So, starting with any eclipse and counting backward or forward or both by this interval a long series can be listed. The one which is to occur on the 21st of next August is the fortieth of such a series of forty-four total eclipses of the sun, the first of which cast its shadow on the South Atlantic the 12th of July, 1211, and the last of which will cast its shadow on the North Atlantic the 3rd of October, 1986. The shadow paths of the entire series are shown on the accompanying maps. They were plotted from calculations given in a monumental work by Theodore Ritter v. Oppolzer, and afford an excellent example of how the rhythm of Nature concealed in mathematical calculations may be graphically revealed.



Map showing series of forty-four total eclipses, beginning July 12th, 1211, in the South Atlantic, and ending October 3rd, 1986, in the North Atlantic.

This series of total eclipses was preceded by a series of partial eclipses visible at the south pole, and will be followed by a series of partial eclipses visible at the north pole and extending the series over a thousand years. The earth's revolution being contained in the Saros with nearly one third remainder causes successive shadow paths of eclipses in a series to be spaced one third around the earth and the paths of any three consecutive eclipses in the series make a spherical triangle on the earth's surface.

The want of similarity between the patterns formed by the eclipse paths of this series in the northern and southern hemispheres requires explanation. It is one of the cardinal principles of science that like causes should produce like effects and the cycles which regulate eclipses have remained unchanged. The cycle of the year does not fit the Saros by eleven days, so that successive eclipses in the series are progressively later in the season. The seventeen eclipses from the 4th of August, 1247, to the 24th of December, 1535, if the shadow could penetrate the earth and reach the earth's axis, would be found to cross the axis progressively farther north. As this spectra covers the spring months of the southern hemisphere when that end of the earth is turning toward the sun, the two motions offset each other so that each eclipse is caused to cross south latitude 35.

The eclipses of this series which fall on the northern hemisphere occur during the summer months when the declination of the sun is nearly stationary and does not offset the northward movement of the successive shadow paths.

The eclipses of the 15th of January, 1572, and before are noted according to the Julian calendar, and the eclipses of the 4th of February, 1590, and subsequently, are noted according to the Gregorian calendar, and this causes an apparent extra spacing of ten days at the point of change.

The series is notable for the number which afforded an opportunity for scientific observations. The eclipse of 1842 had a path of totality from Perpignan, France, through Milan and Vienna, over Russia and central Asia to the Pacific Ocean. The eclipse was of over four minutes' duration at each point and detailed physical observations were made. The path of totality in 1878 was from Wyoming to Texas and included many stations at high altitudes. There were unusual opportunities for photographing the corona at Cherry Creek, near Denver, and at Fort Worth. The eclipse path in 1896 reached from Norway to Japan. The reversing layer of the sun was photographed by Shackleton in Novaya Zemlya, and Russians obtained photographs in Siberia and Lapland.

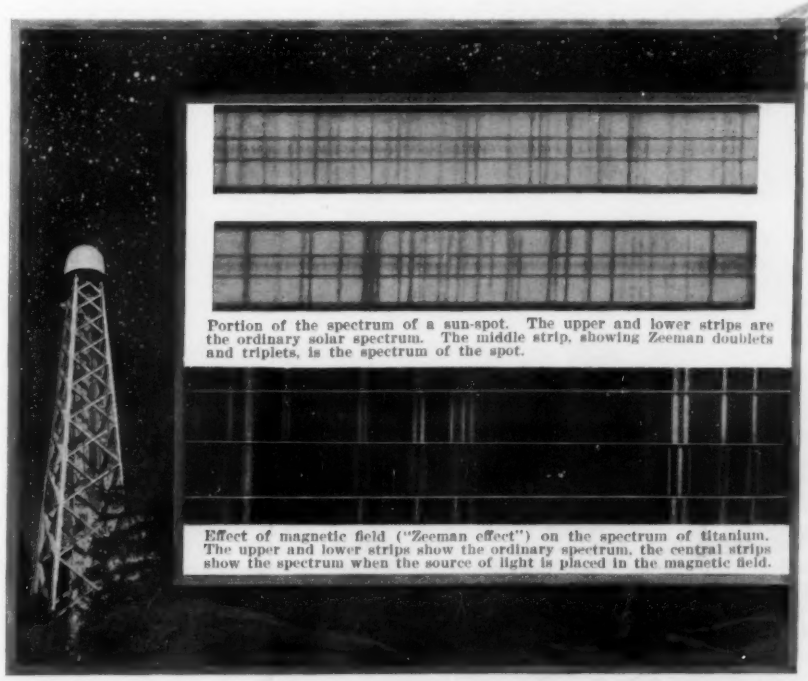
The shadow of the eclipse on the 21st of August, 1914, will begin at sunrise north of North America, lead across the northern end of Greenland, Norway, Sundsval, Sweden, Riga and Kief, Russia, the Black Sea, Trebizond, Turkey in Asia, and into Persia. The United States east of and including the Great Lakes and north of Washington is within the limits at sunrise.

In the chart here presented the paths were plotted by drawing arcs of circles through three calculated points. Owing to the unavoidable distortions of a flat map the paths are, in some cases, in error between the calculated points. For the best available information consult the large maps in the Nautical Almanac.

Recent Progress in Solar Research

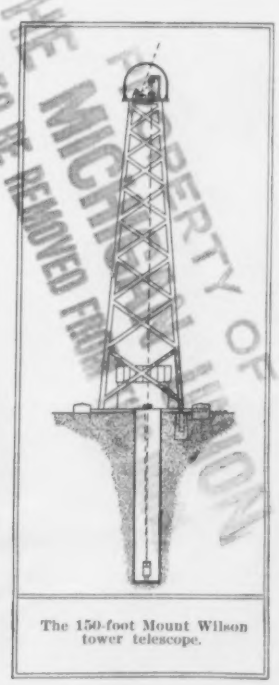
By Walter M. Mitchell, Ph.D.

AMONG the discoveries made during recent investigations of the sun, the most interesting is undoubtedly the discovery of the sun's magnetism. The first evidence of the existence of magnetic action on the sun was obtained through the brilliant discovery by Prof. George E. Hale of the Mount Wilson Solar Observatory, that certain phenomena in the spectrum of sun-spots which had been observed by the writer while at Princeton, were due to the effects of magnetic action in the sun-spots themselves. Within the last year has come the announcement that not only is there local magnetic action in the sun-spots, but that the whole sun is probably a gigantic spherical magnet; and similar to the earth, the poles of its magnetism agreeing approximately with the poles of its rotation. In addition, from the investigations through which this discovery was made, the intensity of the sun's magnetic strength has been found to be about eighty times that of the earth, and the kind of magnetism, or polarity, as it is techni-



Portion of the spectrum of a sun-spot. The upper and lower strips are the ordinary solar spectrum. The middle strip, showing Zeeman doublets and triplets, is the spectrum of the spot.

Effect of magnetic field ("Zeeman effect") on the spectrum of titanium. The upper and lower strips show the ordinary spectrum, the central strips show the spectrum when the source of light is placed in the magnetic field.



The 150-foot Mount Wilson tower telescope.

Instruments and methods used in solar research.

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cally called, is similar to that of the earth, i. e., the north magnetic pole lies near the north pole of rotation.

It will be of interest to describe briefly how these discoveries were made. Nearly twenty years ago, Prof. Zeeman of the University of Amsterdam made the discovery that if the light emitted by a source placed in a powerful magnetic field, for example an electric spark between the poles of a large electromagnet, was examined with a powerful spectroscope, the lines in the spectrum of the element were seen to undergo a remarkable change. Formerly single, they now became double, triple, or even quadruple. From the name of the discoverer this phenomenon became known as the "Zeeman effect." By examining carefully the components of the multiple lines with suitable optical apparatus, it became evident that this multiplication could always be recognized as such, and hence, would afford a conclusive test for the evidence of magnetic action.

Atmospheric Disturbances Observed.

Observations of the sun with an instrument called "spectroheliograph" had given unquestionable evidences of whirlpool or vortex action on the sun's surface in the vicinity of sun-spots. Theoretical considerations showed that the rapid rotation of the intensely heated particles of the sun's atmosphere would tend to generate a magnetic field at the center of the vortex. The writer had detected the presence of doubled and tripled lines in the spectrum of sun-spots at the Princeton Observatory; hence, the very interesting question arose, might it not be possible that these doubled and tripled lines were really Zeeman effects, indicating the presence of a magnetic field in the sun-spot? Through the brilliant investigations of Prof. Hale this was found to be the case.

The Instruments Used.

The apparatus with which this remarkable discovery was made was the now famous "tower telescope." As the equatorial telescope, which is ordinarily used for astronomical observations, had been found somewhat unsatisfactory for solar investigations, it was necessary to devise some other form of apparatus which would be free from the objectionable features of the older style. As an experiment, a preliminary tower telescope was constructed, it being the intention of the Mount Wilson observers to construct a larger and more complete instrument should the experiment prove satisfactory. The tower telescope consists of a tower of light metal framework, at the top of which is placed the principal lens or object glass. By a suitable arrangement of mirrors, driven by clockwork so as to counteract the effect of the earth's motion, a beam of sunlight is directed vertically downward through the object glass. Immediately under the tower, in a pit, is placed a large and powerful spectroscope. The chief advantages to be gained by this novel construction were the avoidance of the effects of atmospheric disturbances, which were found to be greatest near the surface of the ground, and stability and surroundings of constant temperature for the spectroscope. The experimental tower proved the feasibility of this form of telescope, consequently a much larger tower was designed and constructed. This tower was made 160 feet high, the lens, of 150 feet focal length, giving an image of the sun's disk nearly 17 inches in diameter. The spectroscope, 75 feet in length, was placed in a pit 80 feet deep. With this gigantic instrument it is possible to photograph the solar spectrum on the very large scale necessary for the accurate measurements required.

The Sun a Gigantic Magnet.

As we have seen, the existence of magnetic force in sun-spots is indicated by the doubled and tripled lines in sun-spot spectra. Now, if the sun as a whole were a magnet, with its poles near the poles of rotation, the strength of the sun's magnetic field would be greatest near the poles, decreasing as we approach the solar equator. Therefore, the lines in the spectrum of the light from regions near the sun's poles should show the greatest effect, and that from the sun's equator the least effect. To examine the light from any particular region of the sun's surface is a comparatively simple proceeding. All that is necessary is to arrange the apparatus so that the particular region of the sun's image in question falls on the slit of the spectroscope, and the required spectrum will be at once obtained. The strength of the sun's general magnetic field is not sufficient to produce an actual doubling or tripling of the spectral lines, but instead the lines appear widened or broadened. Careful measurement of the amount of this widening at different points on the sun's disk gave results which agreed so closely with theoretical requirements that the correctness of the hypothesis was very strongly indicated, namely, that the sun is a gigantic magnet. The determination of the strength of the sun's magnetic field, however, is a matter of considerably greater difficulty owing to the extreme minuteness of the quantities to be measured, but the results obtained indicate that the strength of the field at the poles is of the order of fifty gausses, that is, about eighty times the intensity of the earth's field. It may be remarked that the strength of the magnetic field in the sun-spots is occasionally as great as one hundred times the strength of the sun's general field.

The Nature of Sun-spots.

The sun-spots themselves have been an ever fruitful cause for speculations regarding their nature since their discovery by Galileo in 1610. Many theories have been advanced, only to be rejected on the advancement of our knowledge of the actual physical conditions existing on the sun. But the recently constructed instruments of the Mount Wilson Solar Observatory have rendered possible the detection and measurement of the small movements of the gases in the sun's atmosphere, so that now we are on a much surer footing regarding our knowledge of their behavior at the sun's surface. For many years it has been known that the motion of a source of light would cause displacements of the lines in its spectrum—the so-called Doppler effect—and that from the magnitude of these displacements it is possible to ascertain the velocity of the source of light as well as the direction of its motion. It is by means of this Doppler effect that we have been able to study the motions of the vapors and gases comprising the sun-spot and its vicinity, and from the results so obtained a tentative hypothesis of the nature of sun-spots has been proposed which bids fair to become adopted. According to this hypothesis, the sun-spot is a vortex resembling our terrestrial tornado or hurricane. On the sun, the vortex is probably deep seated, the spot which we see being merely the disturbance produced in the photosphere by the vortex far beneath it. The circulation, as in the tornado, is spirally upward and then outward along the surface of the photosphere. The displacements of the lines in the spot spectrum show that in the so-called reversing layer of the sun's atmosphere the phenomena represent an actual flow of the gases out of the spot along the photosphere. Low pressure in the center of the vortex causes expansion with consequent cooling, and a dark cloud results, forming the umbra of the spot which is so conspicuous to the eye. As a secondary effect, the gases of the higher regions of the sun's atmosphere, i. e., the chromosphere, are sucked down into the spot.

Sun-spots Periodic Phenomena.

Unfortunately during the last few years there have been few opportunities in which to study the motions of the spot vapors. As is well known, sun-spots are a periodic phenomenon, the maximum number being visible about every 11.1 years. Just at present we are at the minimum period, and a very well marked minimum it is. For during the last hundred years there has been no year in which there have been fewer sun-spots than the year 1913; there being 320 days on which no spots were visible.

Heat from the Sun.

The amount of heat which the earth receives from the sun is always an interesting topic for discussion—particularly at this time of year. While we are still unable to predict the approach of a "hot wave" from any phenomena of the sun, we have found that the amount of heat received by the earth is not the constant quantity that it has been hitherto supposed to be. Technically speaking, the so-called "solar constant" is now known to be variable. The heat received at a given place on the surface of the earth depends upon various conditions, such as the altitude of the sun above the horizon, the time of year (the sun's distance depends upon this), and last, but not least, the conditions of the earth's atmosphere. In order to avoid considering these quantities, the unit known as the solar constant has been introduced. The solar constant is the number of heat units which will be received by a square meter of the earth's surface in a unit of time if exposed to the perpendicular rays of the sun and unprotected by the earth's atmosphere. From the results of recent measurements at the Smithsonian Astrophysical Observatory the value of the solar constant has been found to be 19.3 calories per minute (the calorie being the quantity of heat necessary to raise the temperature of a kilogramme of water 1 deg. Cent.). Converted into more familiar units 19.3 calories are equivalent to about 1.8 horse-power, of which more than one third is lost to us through absorption in our atmosphere.

The determination of the value of the solar constant is greatly embarrassed by the uncertainty of our knowledge of the amount of heat lost in transmission through our atmosphere. Since we are obviously unable to get outside of the atmosphere in order to make measurements, the effect of its absorption must always be, to a certain extent at least, uncertain. Our present knowledge is derived by extrapolation from results of observations made simultaneously at as widely different altitudes as possible. In this country, observations have been made at Washington, D. C.; on Mount Wilson, Cal. (5,886 feet); and on the summit of Mount Whitney, Cal. (14,502 feet). During several years' observations at Mount Wilson, variability, with a range of about 10 per cent, was suspected in the solar constant. The fluctuations seemed to occur irregularly, sometimes with a period of only a few days, sometimes longer. To determine the reality of this it appeared necessary to establish another station so far removed from Mount Wilson that local influences could not be expected to alter the results at both stations on the same day. Such a station was established at Bassour, Algeria, during the summers of the years 1911 and 1912. Simultaneous observations at these widely different stations showed that when high values for the solar constant were obtained at Bassour, high values were also obtained at Mount Wilson, and *vice versa*. Thus the fluctuations which have been found appear to be truly existing in the solar radiation outside of the earth's atmosphere.

Do Sun-spots Influence Weather?

Just what influence upon weather conditions will be found to result from the fluctuations in the solar constant is difficult to say. At first glance it would seem that there must be some effect, but so far observations have shown no signs of it. The conditions which determine the changes in the weather at any given time or place are so numerous and so varied that it is doubtful if a short period variation in the solar constant would produce an effect which could be directly traced to its cause. However, one very curious result has been found in relation to the periodicity of sun-spots, namely, that at times of sun-spot maximum the solar constant has a relatively higher value than at minimum. The curious part is, that observations seem to show that the earth's temperature is slightly cooler at the spot maximum, notwithstanding the fact that if the above result be true, the solar radiation is at this particular time more intense. Up to the present this apparent contradiction has not been satisfactorily explained.

What the future will bring forth in solar research is difficult to predict. The new spot cycle which is just beginning will certainly yield new material from which our knowledge of sun-spot conditions will be increased. Much information is needed with which to test the newer theories of the constitution of the sun; the classical theories have been challenged by recent investigators, for the new data which has been obtained make the premises on which the older theories are based somewhat uncertain. The accuracy of the accepted value of the solar constant is also open to some doubt, as is shown by the discovery of an unsuspected variation in its value. To overcome the uncertainties of low altitude observations, it is planned to equip balloons with automatic registering apparatus. In this way it is hoped to obtain observations at altitudes as great as 100,000 feet, which, if successful, may be expected to remove any uncertainties now existing.

Forty Tons at a Single Scoop

IT is possible to indulge in superlatives when describing the Panama Canal, without much fear of running into exaggerations. As a matter of fact, it was the magnitude rather than the intricate or untried nature of the work at Panama that rendered it famous the world over. Not alone was the work stupendous in itself, but it called for the provision of some of the largest excavating machinery in existence, and the quantities of material handled by these appliances have provided many a record for excavation, transportation and the emplacement of masses of concrete. Two of the most notable machines, in respect of their capacity, were ordered by Col. Goethals, near the close of the work, for the particular purpose of tackling the enormous slides which have delayed the opening of the canal for several months. We refer to the two large dipper dredges, the "Gamboa" and "Paraiso," which were built by the Bucyrus Company, and are now at work cleaning up what remains of the great Cucuracha slide preparatory to the formal opening of the canal in 1915.

The two dredges, which were described in our issue of May 9th, 1914, are of the dipper type. Each dredge displaces about 1,500 tons, and each is provided with two sizes of bucket, one of ten and the other of fifteen cubic yards capacity. For the present the dredges are using their 10-yard buckets, because of the heavy character of the work and the large size of broken rock in the slide. The power of the dredges is well illustrated by the size of the rocks which they have been lifting, several of these having run from twenty to forty tons in weight. The greatest piece of lifting yet accomplished is illustrated on the front cover of this issue, which represents one of the dredges with a rock of forty tons weight carried upon its ten-ton dipper. It was found impossible to place these boulders on a scow, for the reason that in spilling them on, they would have gone right through the bottom. Therefore, they were drilled and mud-capped while resting on the dipper, and in this way they were broken somewhat, so that the dredge was able to pick them up in smaller pieces which could be handled on the scow. When the material encountered becomes less severe, they will be equipped with their 15-cubic yard capacity dippers. At present these are the two most powerful dipper dredges in existence.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Non-sinkable Ship Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

You have discussed non-sinkable ships. Why not build one? I have seen a non-sinkable motorboat. Why not a ship?

We simply filled the vacant space in the boat with small air-tight cylinders, and the trick was done. One hundred one-gallon, air-tight cylinders giving about 600 pounds buoyancy were easily stowed under decks and other vacant places, and if half the bottom was torn off the boat would float.

If all the vacant space in a liner were filled in a similar manner, and, if necessary, some space usually allotted to cargo, passengers, etc., utilized, the liner would not sink if half a side was torn open, or if she was cut half in two.

Of course, some of the small air-tight cylinders would be crushed in a collision or other accident, but an excess of cylinders should be stowed to provide for possible loss. This idea may be a golden dream or a wild scheme unworthy of notice, but I believe a million small air-tight cylinders properly stowed would solve the problem. Take it for what it is worth.

Buffalo, N. Y. J. W. KALES.

[The plan of our correspondent might be feasible in small vessels, such as motorboats and lifeboats; but because of painting necessities and difficulty of inspection, it would be impracticable in a liner.—EDITOR.]

Suggestion for Measuring the Speed of Yachts

To the Editor of the SCIENTIFIC AMERICAN:

In reading the issue of July 11th, I was quite struck with an article, or rather communication, of Mr. F. B. Abbot of Sharon relative to the testing of a yacht's speed with a log. While there is little doubt but that he is right, I would say that there is a way which may be available to obtain this same data, which I wonder has not been made use of before, or been suggested. I refer to the use of the position finding equipment which is installed in all of our coast fortifications. While descriptions of this equipment have from time to time appeared in your valued paper, it may be as well to state that in brief the method employed is to plot on a so-called plotting board the position of the target at a given interval of time, the standard for the present being 30 seconds. This plotting is done on a scale of 300 yards per inch. A travel of approximately fifteen yards in an observation interval of 30 seconds represents a speed of one mile per hour. This is represented by a distance of one twentieth of an inch. Hence a change in speed of a half a mile should be readily discernible on the plot. The advantages of this method over the use of the log would seem to be manyfold. In the first place much shorter runs can be used to obtain the data desired than would be the case were a log employed.

Furthermore, a record of the compass course compared with the plot will give one a very accurate line on the leeway made in the case of a sailboat. Without going further into the advantages of this method it seems that there can be little doubt of the possibilities of it to anyone who gives it serious thought. Of course it would be necessary to obtain the co-operation of the War Department or the officers in command of convenient posts, but considering the attitude of both the Army and Navy Departments in the past toward all kinds of health sports, there should be little to be feared from opposition to the plan.

If the work should perhaps prove too onerous to the regular troops stationed at a post, undoubtedly volunteers could be obtained from the coast artillery reserves, who would be glad to co-operate in this work.

Boston, Mass. HAROLD H. BROWN.

The Introduction of Vaccination into the United States

To the Editor of the SCIENTIFIC AMERICAN:

I recently read in a medical work, in reference to vaccination for small-pox, as follows:

"Vaccination for small-pox was first introduced into this country in 1799, by Prof. Benjamin Waterhouse, first professor of medicine in Harvard University."

As a matter of fact, however, the practice of vaccination was introduced seven years prior to the date as ascribed to Prof. Waterhouse.

As vaccination has become a very important factor in the general welfare of the country, perhaps you would care to publish a short statement of its introduction into this country, as it may prove of value as a record. With your permission, it will be necessary to quote a little from family history, the subject being my paternal grandparent.

"William Yates was born at Sapperton, near Burton-on-Trent, England, November 13th, 1767. He inherited his father's estates and titles, and was a cousin of Sir John Howard, the philanthropist, and Sir Robert Peel. He took up the study and practice of medicine as a pastime, attending the poor and needy free of charge.

"Dr. Yates became distinguished as a philanthropist. He studied with Dr. Jenner, the discoverer of vaccination, and became one of Jenner's most enthusiastic supporters. Becoming deeply interested in the new republic (the United States), and its principles, he abdicated his titles to a younger brother and came to Philadelphia, Pa., in 1792, bringing with him some of Dr. Jenner's virus. He then made public the discovery in Philadelphia, and practised vaccination there and elsewhere for many years. Having made the acquaintance of Judge Cooper of Otsego County, N. Y., Dr. Yates purchased a large tract of land in the same county, where he resided until his death, March 7th, 1857."

It may be worth noting that the method first used by Dr. Yates in vaccinating was to apply it to the hands and between the fingers in imitation of the natural way "cow-pox" was acquired by the milkmaids in England.

If there is record of vaccination prior to the above date I should be glad to be advised. N. S. YATES.

Honeoye Falls, N. Y.

The "America's" Trip Postponed

The Test With Three Motors

By Our Staff Correspondent at Hammondsport

PURSUANT to the programme announced in last week's SCIENTIFIC AMERICAN, Mr. Curtiss installed in the airboat "America" a third 90 horse-power motor and a direct-connected 8-foot Garuda propeller which protruded before the leading edge of the top plane, while the engine rested on a trestle work supported by the main spars. Along each side of the bow, flush with the chines, he attached an early type of efficient, bilge-keel-like, unbuoyant planing fin, 18 inches wide at its rear end, and curved to a point at its front, where it terminated with an upward bend, near the prow. These fins, as the vessel acquired headway, were to exert a dynamic lift and enable the boat readily to mount the water surface and plane efficiently before rising into the air. The third motor was cranked from the aviator's seat by pulling a cable leading to a ratchet crank on the rear end of the engine shaft. These changes occupied the workmen from Saturday evening, July 18th, to the following Wednesday night.

Next morning Mr. Curtiss, as pilot, launched forth with five additional men and sufficient supplies and ballast to make a total load of 4,500 pounds. Under the full thrust of her Garuda and two Olmstead propellers the great craft came quickly to the surface, planed handsomely, and rose into the air with great ease. She was attended by several motorboats bearing expert witnesses, and by the Curtiss "scooter" carrying three naval officers, and skimming over the surface at 40 miles an hour. A large throng of citizens and tourists witnessed the event from the shore. Going from shore, Mr. Curtiss quickly distanced all the water craft. Returning with throttled engines, he played the "America" in hundred-yard bounds along the surface, followed at even pace by the strenuous scooter and the three naval officers, their hair streaming and shirt sleeves fluttering. It was a novel sight, this saucy sea dog straining at terrific pace, as if to devour the great red-winged whale, frolicking along without effort a yard or two above the water. On a subsequent trial the scene was enlivened by boatloads of spectators, camera men, and a moving-picture operator standing erect in a swaying naphtha launch and turning his crank with sublime energy and gravest attention to business.

In the early evening Mr. Curtiss made a triumphant flight which seemed to justify his best expectations of the third motor. Taking with him three passengers and enough supplies and ballast to aggregate over 6,100 pounds, he flew the "America" with as much ease and security as he had ever done with the lightest burden. The useful load was 2,600 pounds, all that seemed necessary for a non-stop flight to the Azores, even with three motors running.

Next evening a run was made to find the rate of fuel consumption. Porte and Hallett flew light to Pen Yan and return, thus doubling the length of Lake Keuka, and covering forty-four miles. The third motor was inactive, but turned slowly under the wind-mill torque of its idle propeller. The fuel consumption averaged about a pound and a half per mile, or was so reported. At full load the rate would be rather more. Thus over 1,800 pounds, say a ton, of gasoline would be required for a fair run to the Azores. This taken from 2,600 pounds useful load leaves 600 pounds for pilots, provisions, oil, and a little margin of fuel. As only one pound of fuel per mile had been allowed in previous estimates, this run was disconcerting. Further tests were required to improve the efficiency of the propulsive system and of the craft as a whole. It was also recalled that during the past month some slight accidents had happened which, should they occur at sea, might terminate prematurely the transatlantic voyage.

Next morning, July 25th, Mr. Curtiss recommended to Mr. Will Gash, Rodman Wanamaker's representative at the trials, a postponement of the ocean flight till October. August was too near; September too stormy. Less than a week remained to perfect the "America" and ship her to New York, for the boat of August 1st, so that she could sail from Newfoundland by the full moon. In so brief a time, many improvements would have to be left untried; some blemishes left unremoved which might jeopardize the success of the voyage. Mr. Gash, after consulting Lieut. Porte, agreed, on behalf of Mr. Wanamaker, to Mr. Curtiss's proposal. After all, Mr. Wanamaker's chief objective was not so much flying the Atlantic as perfecting a craft capable of flying it with security and precision.

The "America" was now returned to the factory to be remodeled in accordance with the month's experience. Her bottom would be lengthened and more gradually rounded upward toward the prow; it would also be widened to give the effect of the very efficient planing fins. The step would be more nearly flat, the fore part of the bottom would become more deeply concave toward the prow. The vibration of the motors would be corrected. Various minor improvements would be made, and the airboat would be ready for a new trial in about two weeks. In the meantime Lieut. Porte and the other newspaper correspondents would discontinue their daily stories, retire from Hammondsport, and allow Mr. Curtiss to pursue the even tenor of his way.

In order to overcome the difficulty the aeroplane "America" is encountering of carrying sufficient gasoline for the long flight of 1,200 miles from St. Johns to the Azores, the Aero Club of America proposes to locate a supply boat on the Flemish Cap shoal, 420 miles southeasterly from St. Johns, thus dividing the first long lap into two of moderate length. As the first portion of the flight would be made at night, it is believed that a flare on the supply barge would enable it to be easily found.

Horace C. Hovey

IN noting the decease of Dr. Horace C. Hovey on July 27th, 1914, at his home in Newburyport, Mass., in his eighty-second year, we lost a valued contributor to the SCIENTIFIC AMERICAN. He was a western man by birth. His father, Edmund Otis Hovey, residing at Crawfordsville, Ind., was founder, trustee, and treasurer of Wabash College there, and occupied the chair of geology and chemistry.

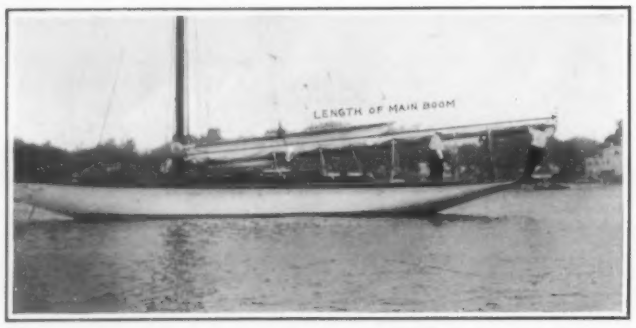
Dr. Hovey was graduated from Wabash College in 1855, and later at Lane Theological in 1857. In 1858 he was ordained for the ministry, and became pastor of Congregational and Presbyterian churches in the eastern and western sections of the country, finally locating in New England, the latter part of his life. His interest in geology never abated. He was particularly at home on the subject of cavern geology and the origin of caves, especially the great Mammoth cave in Kentucky; also the Luray cave, in Virginia. In 1912 there was published an authentic "Manual of the Mammoth Caves of Kentucky," edited by Dr. Hovey and R. Ellsworth Call, M.D., Ph.D., illustrated by maps and engravings, written in a popular, interesting style, and is a fitting memento of Dr. Hovey's abilities in this direction. He was an interesting and entertaining lecturer and a fluent writer. He leaves a son, Dr. Edmund Otis Hovey of New York, geologist and curator in the New York Museum of Natural History.

Dr. Hovey was a member of the American Association for the Advancement of Science, the Geological Society of America, the International Geological Congress, and Society of Spellology.

The Current Supplement

THE opening article of the current SUPPLEMENT No. 2014 is intended to present to the general engineer an idea of what the Diesel engine is and to show its possibilities.—The proposed improvement of the Norfolk Navy Yard is described and illustrated.—Prof. Henry G. Gale writes most interestingly on the experimental determination of the earth's elastic properties.—One of the most important contributions to the literature of the aeroplane is a paper which Mr. Frederick William Lanchester recently read before the Institute of Civil Engineers in London. It is entitled "The Flying Machine from an Engineering Standpoint," and the first installment of it is published in the current SUPPLEMENT.—A good account is published of the Lassen Peak eruptions with photographs.—Mr. A. J. Wallis-Tayler's paper on the preservation of wood is concluded.

Measuring perpendicular height of the mast.



Taking the length of the main boom.

How Yachts Are Measured

Determining the Rating of a Racing Yacht for Classification and Time Allowance

By Herbert T. Wade

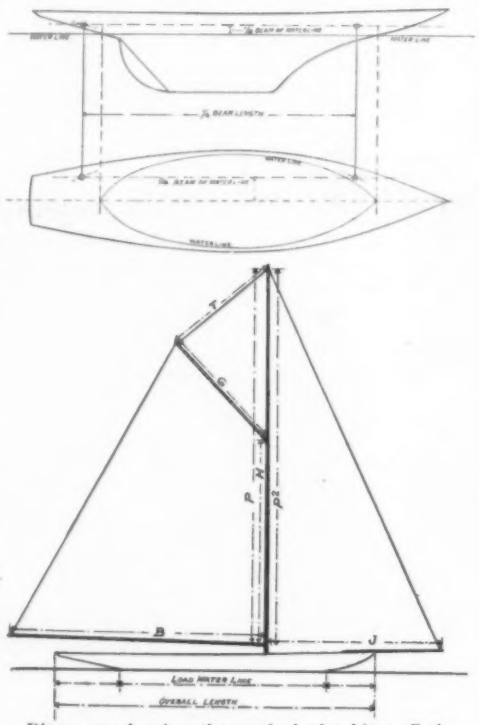
Measuring the hoist of the mainsail.

THE measuring of racing yachts for purposes of classification and time allowance presents many points of interest. The subject not only has wide general interest, but is of importance at the present time in view of the coming races for the "America's" Cup, in which the deed of gift and the supplemental agreement under which these races are sailed provide that the racing rules of the New York Yacht Club, with modifications duly agreed upon, should apply. These racing rules, which are fundamental in American yachting, and which, as regards measurement and rating, it may be said, vary somewhat from those in force in Great Britain and elsewhere in Europe, provide that a yacht should be rated for classification and time allowance according to a mathematical formula into which certain quantities derived from actual measurement enter.[1] As thus defined the measurement or rating of a yacht is 18 per cent of the product of the waterline length multiplied by the square root of the sail area, divided by the cube root of the displacement, or expressed as a formula:

$$\text{Measurement} = 0.18\,\frac{L\sqrt{S\ A}}{\sqrt[3]{D}}$$

This is the measurement and rating for classification and time allowance, but the rules also provide that a yawl shall be rated at 93 per cent and a schooner at 90 per cent of their measurements as determined from the above formula. The reason that the factor 18 per cent is used, is to reduce the numerical value obtained from the formula to a figure approximating the actual length of the yacht, so that a yacht of 50 feet rating might correspond in length somewhat to that figure rather than to a numerical expression that otherwise would mean nothing.

This fundamental formula naturally is based on the fact that the longer the boat on the waterline the larger and more powerful it will be. Obviously, as the sail area is increased, the rating which involves both speed and power should increase, but, as the formula indicates, it will vary not directly with the increase in the sail area, but as the square root; that is, four times the sail area would double the rating. On the other hand, a large displacement would act to reduce the rating; consequently the cube root of the actual displacement is used, so that an owner is encouraged to build a boat with a large displacement so as to secure seaworthiness. The length *L*, as used in the formula, is not, however, the actual load waterline length or



Diagrams showing the method of taking off the quarter-beam, sail area, and waterline measurements.

distance between the points farthest forward and farthest aft in the plane of flotation; nevertheless this is the distance from which all calculations are made, including the displacement, quarter-beam length, and draft. *L* is a corrected length, which includes the load waterline length plus one half the excess of the quarter-beam length over the percentage of load waterline length given by the formula:

$$\text{Percentage} = 100 - \sqrt{\text{L. W. L.}}$$

The quarter-beam length is a dimension measured in a line parallel with the middle fore-and-aft vertical plane, at a distance from it equal to one fourth the waterline breadth and one tenth of its breadth above the load waterline plane. For boats over 100 feet load waterline the percentage in the formula above is 90. Provision is made for bridging concavities or local jogs or notches at the point of measurement to prevent cheating the measurement.

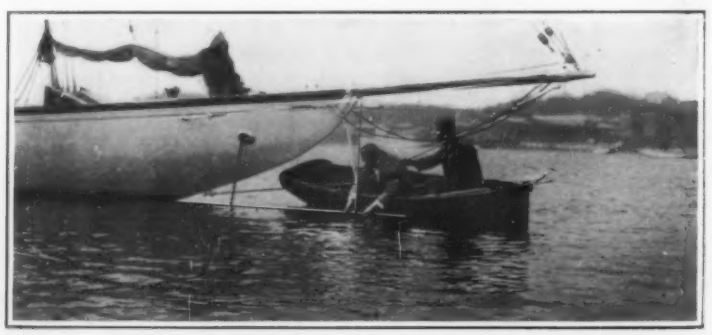
The quarter-beam provision is introduced to prevent the scow type of floatage, and, like other provisions in the racing rules, serves to penalize ships that might not prove generally seaworthy, yet have a high speed under certain conditions. In fact, the whole general scheme of rating, classification and penalties aims at the elimination of freak vessels. It might be said in passing that American design has moved away from freak vessels, and what exception could be taken to the modern American racing yachts in regard to their seaworthiness must be based rather on structural features, as lightness of construction has been carried to such a point that the racing yacht has had its weight reduced to a point where, if not comparable to an airship, yet it shows a marvelous degree of lightness that is not in keeping with permanence or with cruising strength such as might have been associated with cup defenders and racing yachts of an earlier date.

In actually measuring a yacht, the official measurer, supplied with a steel tape carefully standardized, makes a series of measurements of and aboard the vessel. To obtain the actual waterline the tape is stretched horizontally on deck from the extreme bow of the vessel to the extreme taffrail and the distance noted. This, of course, requires that the tape should be stretched around the mast, and a correction for this small amount must be made before the true length is found. Then from the extreme points at the bow and stern a plumb-line and bob is dropped, and the measurer, or one of his assistants, notes the distance on a floating batten, or spar, from the point of the bob to the point of contact of the batten with the bow or cutwater at the waterline. The same process takes

(Concluded on page 105.)

[1] It is reported that several foreign yacht clubs are now considering the adoption of the American scheme of measurement.

Measuring the stern overhang.

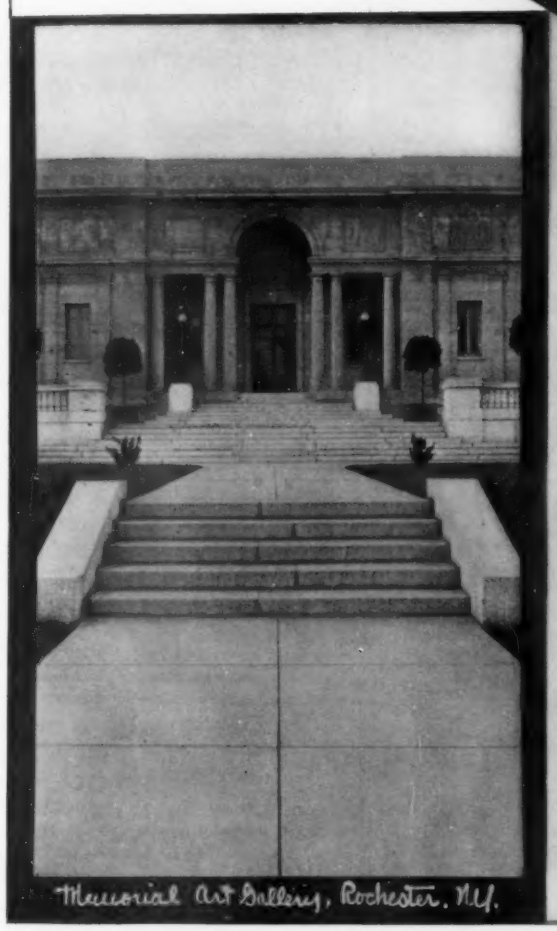


Determining the bow overhang.

A Fortune for a Simple Invention

The $300,000 Attachment Which Enables a Kodak User to Write a Record on an Exposed Film. The Inventor's Account of His Device

George Eastman, who paid $300,000 for the autographing attachment to the kodak. This is one of the largest sums which has ever been paid outright for an invention.



Record made on picture by means of Mr. Gaisman's invention.

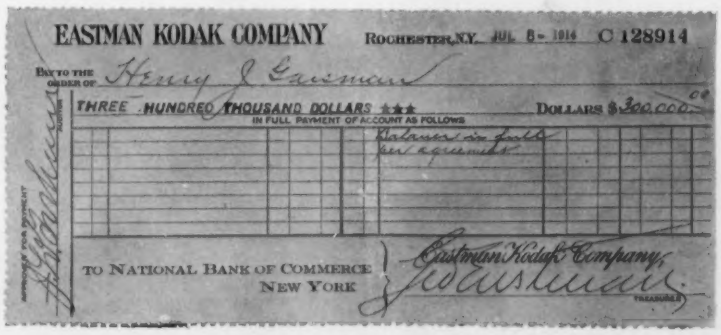
Henry J. Gaisman, inventor of the attachment.

The Autographic Kodak

THE autographic kodak attachment, of which we have heard so much, is located on the back of the camera. It is essentially a spring door covering a narrow slot through which it is possible to write upon the film.

The autographic film is different from other films in that it is made with a thin red instead of the familiar thick red and black (duplex) paper. When the small door in the back of the camera is open it is possible with a metal stylus or lead pencil, or any pointed instrument to write on the back of the red paper, thus exposed. Between the red paper and the film is a strip of tissue paper. The tissue paper serves two purposes: it supplements the red paper in making the film cartridge light-proof, and it permits the recording by light of the writing upon the film.

The device may be used either to record the title, place and date of the picture, or to make a record of the time, exposure and conditions of exposure. In other words, the autographic kodak is of equal value to the amateur and the professional. The amateur, perhaps, is taking pictures in unfamiliar territory. It may be several weeks before the photographer will see his developed films and prints from them. In the meantime he is likely to forget some of the unfamiliar scenes or some of the unfamiliar faces. That cannot happen when the new camera is carried. With his stylus the photographer will write through the little door the title of the picture, or whatever notes he pleases. When he develops the film he will find his words recorded at the bottom of each film, to appear in the print he wishes or to be cut off once the picture is identified. The professional can record on every exposure light, conditions, stop, etc. When he comes to develop it he can easily see where he failed, and prevent a like mistake next time he goes out.


EASTMAN KODAK COMPANY
ROCHESTER, N.Y. JUL. 8- 1914 C 128914
PAY TO THE ORDER OF Henry J. Gaisman
THREE HUNDRED THOUSAND DOLLARS ***
DOLLARS $300,000.00
IN FULL PAYMENT OF ACCOUNT AS FOLLOWS
Patents in full for equities
TO NATIONAL BANK OF COMMERCE NEW YORK
Eastman Kodak Company,
TREASURER

Fac-simile of the check received by Mr. Gaisman.

How I Came to Invent the Autographic Kodak

By Henry J. Gaisman

THE real story of the invention of the autographic kodak dates back to the time when I first met Mr. George Eastman, a great many years ago. I had just invented and put on the market the auto-strop safety razor. About that time I met Mr. Eastman in an informal manner, and told him about the good points of my invention. Mr. Eastman was so interested that I sent him an auto-strop safety razor; he was so delighted with it that he purchased a number of the razors and gave them away to his friends.

In return Mr. Eastman gave me a very fine kodak. Up to that time I had not been interested in cameras, but the charm of photography soon asserted its sway. I began to think of ways in which the camera might be improved. It seemed to me that what the instrument lacked was some means of recording on the film itself what pictures were taken and when the exposures were made. I am not going to tell you of the long period of doubt and anxiety which followed the conception of the thought of a self-recording camera.

(Concluded on page 106.)

A Huge Tesla Apparatus

A Coil With a Seven-foot Spark Gap

By Father Francois Magri, S. J.

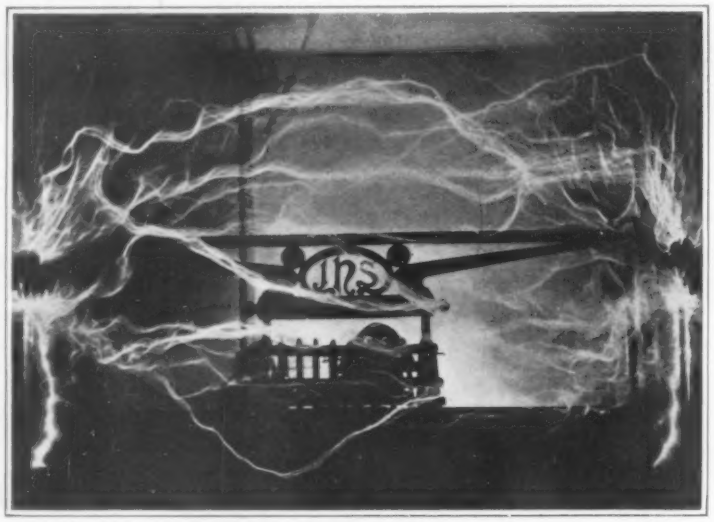
THE great Tesla apparatus of our physical laboratory, at the College of the Immaculate Conception, Montreal, was designed by my predecessor, Father Gendreau, and was constructed by his pupils.

The current of low frequency which energizes the Tesla coil proper, is furnished by a 7-kilowatt transformer, entirely immersed in insulating oil in a glass case, which measures 27 inches in length, and 17 inches in width and height. Its primary coil is connected to the city lighting circuit of 115 volts and 60 cycles, from which it takes a current of 60 amperes. The voltage of the secondary current exceeds 65,000 volts, as is proved by the length of the spark, which has the flame-like appearance shown in one of the photographs. This secondary current passes into the primary coil of the Tesla transformer, which is connected with a condenser of 144 Leyden jars. These jars are filled with and surrounded by salt water, which takes the place of the customary metallic coatings, and which is covered by a thin layer of oil to prevent evaporation and incrustation. A rotary interrupter, driven by an electric motor, is employed in order to increase the frequency.

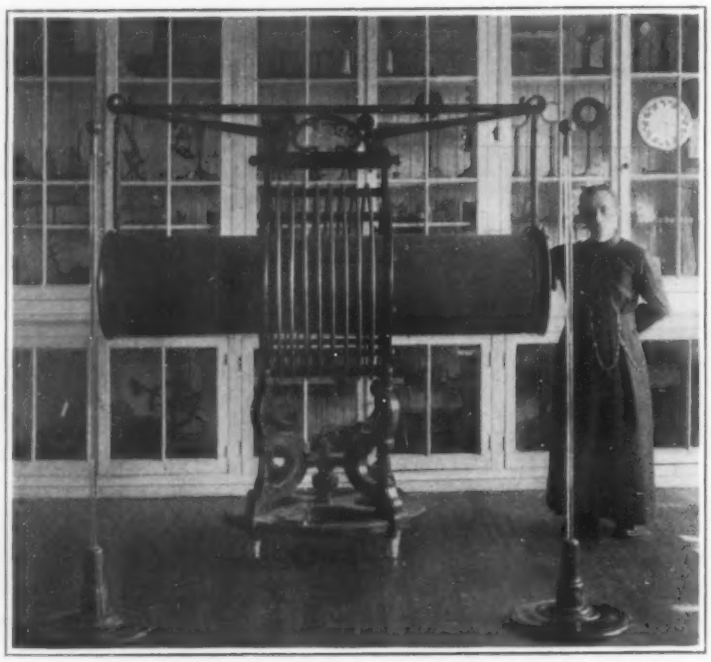
I have made important changes in the apparatus, entirely reconstructing the primary of the Tesla, and improving the insulation by mounting the wooden base on glass supports. The apparatus is more than 7 feet long. A cylindrical cage, 33 inches in diameter, composed of 12 longitudinal bars, 22 inches long, carries the primary coil, which consists of 8 turns of brass tubing, separated by intervals of 1½ inches. The diameter of the tube is ⅝-inch, and its total length is 74 feet. Its ends are connected with the condenser and the rotary interrupter. Above this coil is a bridge, from the ends of which the secondary coil is suspended inside the primary by means of two ebonite rods 19 inches long. The secondary coil is nearly 7 feet long and more than 17 inches in diameter. It is composed of more than 1,000 turns of fine, enameled copper wire, insulated by layers of tarred paper and cloth. The maximum sparking distance is 6 feet 8 inches usually, but it has exceeded 7 feet. The spark resembles a flash of lighting and, with its deviations, attains a total length of nearly 10 feet. It produces a sound like a thunder clap that startles persons in the street, 400 feet distant. Although the apparatus is not connected either with an antenna or with the earth, the sound of the discharge is heard very distinctly through the telephonic receiver at the wireless station of the Polytechnic School, a mile and a half away, this receiver also being disconnected from its antenna and the earth.

What, then, would be the result of connecting this powerful apparatus to earth and to our experimental antenna, consisting of three wires, each 700 feet long? The discharge would certainly produce a potential difference of at least five million volts, but we have no apparatus with which this theoretical deduction can be verified.

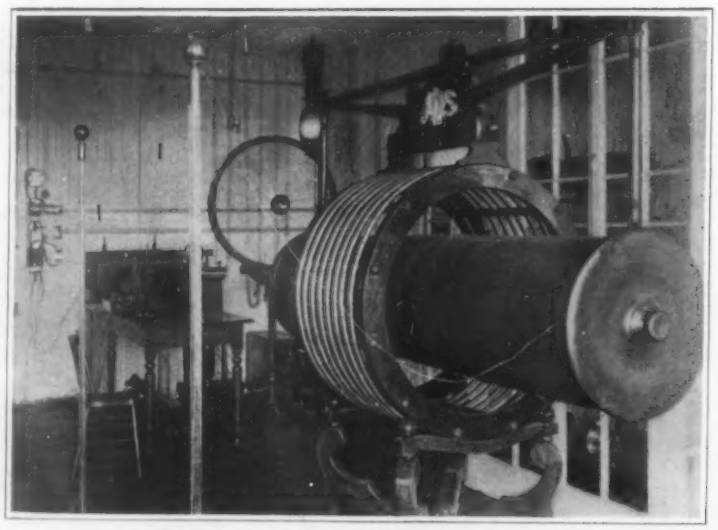
The discharge of the primary coil alone produces a deafening noise. This coil, by induction alone, heats to incandescence a 50-volt lamp, inserted in a little coil of three turns at a distance of 3½ feet. A 25-volt lamp glows brightly at the same distance, and a 12-volt lamp is heated to whiteness at a distance of 5¼ feet. When the terminals of the primary are connected by a coarse iron wire 8 feet long, the wire is almost instantly heated to incandescence and fused. Sixteen 115-volt lamps glow white when they are connected in series between the terminals of the primary.



Discharging across a seven-foot gap.



Giant Tesla coil capable of giving a seven-foot spark.



View of the primary and movable electrodes.

A Monumental Bibliography of Science.—After a lapse of 12 years a new volume has appeared in the Catalogue of Scientific Papers, published by the Royal Society of London, viz., Vol. XIII, beginning the Fourth Series, which is to embrace all scientific papers published during the period 1884-1900, and winds up the work. This volume contains 11,551 entries of titles of papers by 2,001 authors whose names begin with A, and 51,720 entries of papers by 6,928 authors whose names begin with B; in all, 63,271 titles. In the preparation of the catalogue 1,555 serials were examined. The Royal Society Catalogue grew out of a suggestion made by Dr. Joseph Henry of the Smithsonian Institution, to the British Association in 1855, and the first volume appeared in 1867. The volumes of the first series include the literature of the years 1800-1863; those of the second, the literature of 1864-1873; and those of the third, that of 1874-1883. The fourth series will round out the century. Supplementing the volumes of the main work, in which titles of papers are arranged under authors' names, the latter being in alphabetical order in each series, a series of index-volumes is in course of publication, in which the periodical scientific literature of the whole century is grouped under appropriate subject headings. Three index volumes have appeared, viz., Pure Mathematics, Mechanics, and Physics (in two parts). There will be seventeen of these index volumes. Finally, the scientific literature since 1900 (including titles of books as well as of articles in periodicals) has been catalogued regularly in the seventeen annual volumes of the International Catalogue of Scientific Literature, which is published by the Royal Society on behalf of an international council.

The Psychology of Catching in Baseball

By Arthur Macdonald

SPECIALIZATION has developed a tribe of catchers who are clumsy on their feet, usually weak at the bat, poor base runners, and of very little value when sent to other positions. Yet the catcher has a most important position, as director and transmitter of signals. Good fielders and hard hitters there are who are not quick-witted, but never a catcher, who is the first to see signs of weakness in the pitcher, and sends word to the bench for another pitcher to warm up. Three years' experience with a major league is regarded as necessary to make a catcher competent. Only a few continue long enough to have such experience.

Good catchers say that when they hear the ball touch the bat their hands instantly fly toward the ball, no matter where it glances off the bat. Some after losing sight of a fly in the sun have the ability to reach it nevertheless.

Sometimes catchers are unjustly blamed for not putting a runner out who gets a big lead off the pitcher (who is really at fault). Here not only a good throw will fail, but it is often useless to throw at all.

Good Catchers Make Many Unexpected Throws.—The catcher must throw from an unnatural position, and with a jerky motion of the arm. Archer threw with a snap of the arm while standing flat-footed and put many out on first base.

The catcher signals second baseman that he is going to throw the next pitched ball to him; the pitcher delivers it a little to one side, so that it can be handled easily; the shortstop knows the next ball will not be hit, and so can back up second base. This unexpected throw often puts the runner out on second. A similar play is when the runners move up every time the ball is pitched. If those on second and third both get well off the bags, the catcher again signals the pitcher to waste a ball, and makes as if he were going to throw to third, but instead, throws quickly to second and retires the runner there. Or makes as if he were going to throw to second, but instead, throws just beyond the pitcher when the baseman starts for second, and he, without stopping, runs up, catches the ball and sends it home to retire the man seeking to score.—Abstracted from *American Physical Education Review.*

A Wheelless Tractor

SOMETHING really new in traction engines is unusual nowadays, since tractors have become fairly well standardized and many of the odd types described in previous issues of the SCIENTIFIC AMERICAN have failed of commercial success.

The accompanying illustration, however, seems to show a brand new departure from the caterpillar, or endless track, type which has become well established in this country.

Previous models of endless track machines have had a three-point support, in that a front wheel or track was used. In this tractor the entire weight is borne upon the two tracks, each of which has a bearing surface 80 inches long in contact with the ground.

Two widths of track are provided—13 and 30-inch, giving, respectively, 2,080 and 4,800 square inches of bearing surface. This reduces the pressure per square inch to 5.77 pounds for the 13-inch track and 2.8 pounds for the 30-inch track. A 1,200-pound horse, wearing a No. 4 shoe, exerts a pressure of about 21½ pounds to the inch in pulling, and a 170-pound man, with a No. 8 shoe, about 9½ pounds. Hence this tractor is expected to work even under extreme conditions of snow, mud, or ice.

Steering is accomplished quickly and easily by two foot-pedals, each of which governs one of the independently driven tracks. By slowing up or stopping one track, the other is made to do the driving, with a very short turn as a result. Without a trailer, the tractor turns in a 12½-foot circle, outside measurement.

The long track is carried on a jointed truck, allowing it to adapt itself to uneven ground. On the narrower track unit a single steel casting takes the place of a built-up shoe and links. There are twenty-five units in each track. The tractor is moved forward by a sprocket meshing with the joints of the track, which lies stationary upon the ground as the truck wheels carrying the weight of the tractor roll over it.

A 6 by 7-inch 4-cylinder motor is used, delivering 20 horse-power at the drawbar. Two speed, 2⅛ and 3½ miles, both forward and reverse, and a belt pulley for stationary work are features.

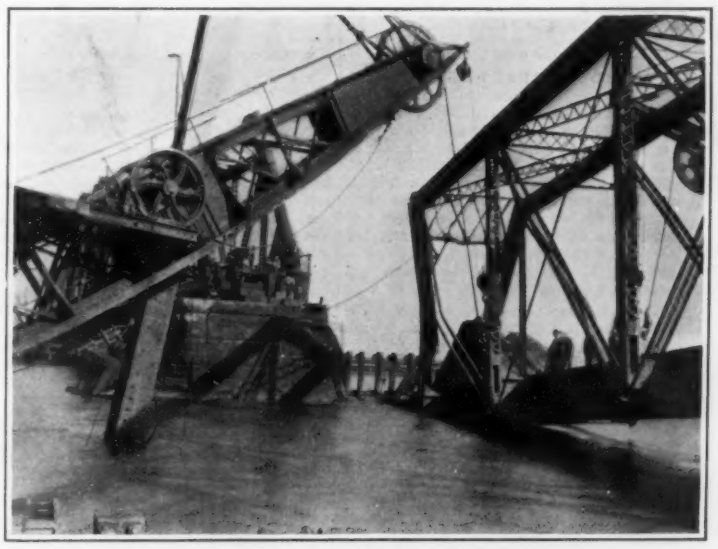
The majority of these tractors sold are engaged in reclamation work in Louisiana. However, in spite of the higher cost, it is expected that they will become popular in general farm work, being especially adapted to use in small, fenced fields, and on land in a high state of tillage. There is even a prospect of successful use in cultivating cotton and corn, as the tractor can straddle rows until the plants reach a considerable height. Partial arrangements have been made for a trial in metropolitan street-cleaning work after the first heavy snowfall of next winter, and further fields in irrigation and road-building work are opened by this unique construction.

A new type of small caterpillar tractor.

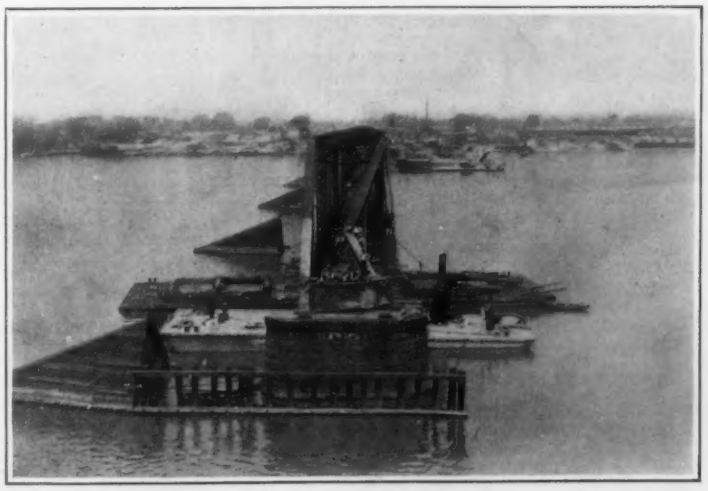
Raising a Wrecked Bridge With Dredges

A STEAMER entered the Maumee River at Toledo recently, towing a 360-foot steel barge. A railway bridge was passed without trouble, but while going through the draw of the Wheeling and Lake Erie bridge, the barge slewed over sharply. Although the steamer cast off the tow line, the steel barge struck the bridge and wrecked the span.

The span measured 177 feet and weighed 210 tons, but it was readily raised and reseated by means of two dipper dredges with a rated hoisting capacity of about ninety-five tons. Hoisting tackle was attached to the booms of the two dredges and made fast to the lower chord of the span at the third panel from the end. Then the hoisting engines of the dredges were operated to lift the end of the span out of the water, and a water ballasted scow was placed under the span as near the end as possible, and blocked up to take a bearing against it. When the water was pumped out the scow raised the span high enough to permit of placing a second scow under the end. The span was then gradually lifted high enough to be pulled back upon the masonry, false work being placed under the end of the bridge, and the damaged steel work repaired where necessary.



Raising the span with two dipper dredges.



Repairing the span while it is supported by the scows.

The Hardening of Soft Fats and Oils

IT was recently reported in trade circles that a German firm had secured a patent for hardening whale-oil. This has again called attention to that most important problem—How can soft fats and oils be hardened? At last it may be said that an answer has been found to the riddle, thanks to the untiring researches of Prof. Sabatier of Paris and Dr. Normann.

For a very long time past chemists have been devoting their endeavors to increasing the melting point of liquid fats to such a degree that they would remain solid at all ordinary temperatures. The actual difference between a solid and a liquid fat is really very slight; both in common are composed of carbon, oxygen, and hydrogen, but the percentage of hydrogen is less in oils than in solid fats. Hence the point at issue was to supply liquid fats, or oils, with the missing hydrogen.

It was a well-known fact that certain metals (as, for instance, platinum when finely pulverized or drawn to form extremely fine wires) possess the peculiarity, when in a freshly refined form, of absorbing gases, and more especially hydrogen, in large quantities which are again given off under favorable conditions. Now Prof. Sabatier discovered that if finely broken up metals (such as platinum, paladium, and nickel) be combined with hydrogen and other substances capable of absorbing hydrogen chemically, then this process will actually take place. From this it was easy to assume that first of all the metal takes up the gas, in order to transfer it at once to the body or bodies capable of absorbing it. To Dr. Normann the credit is due of first applying this new process to oils, fats, and blubbers.

In this way it has now become possible to harden a cheap raw material; in other words it can be transformed into a substance of higher value. Fish-oil cannot only be hardened, but it also loses its unpleasant smell and taste, and the hardened product resembles snow-white odorless and tasteless beef-suet. Olive oil, rape-oil, groundnut oil, etc., can also be transformed by this new process into a solid practically flavorless and aromaless tallow. Castor-oil becomes a hard, brittle body, which can be crushed and ground just like sugar. There is, however, still another point to be solved by chemists, viz., the transformation of non-saponifying substances into such as are capable of saponification, whereby a vast field of utility would be opened up to petroleum and, should it ever become possible to change petroleum into a sebacic acid from which a good odorless soap could be made, then a wide field of profit is opened up to the industrial world. In the very first place a marked drop in the prices of soaps in general would be induced.

For the time being the Sabatier-Normann process will prove of special value to the whale-oil industry. Just at the same time when this invention was perfected, fresh hunting grounds for whales have been found in the Southern Polar Seas, and the catches are already exceeding the most sanguine hopes. In Norway, the home of whale fishers, whale fishing companies sprang out of the earth like mushrooms, and the capital at present invested in the industry is valued at 100 million crowns. According to the last returns 800,000 casks of whale-oil were produced in one year; as a full-grown whale only gives 20 casks of oil, under the most favorable conditions, this means to say that about 40,000 whales are killed every year. As these creatures breed very slowly, it is feared that, should this slaughter be long continued, the whale will ultimately die out, and the governments interested now propose to lay down laws regulating the killing of these mammals. The fact that, for the reasons above stated, any flooding of the market with whale-oil is out of the question, is of special interest to all enterprises handling raw oils, because they perceive a serious competitive product in the hardened whale-oil made by the Sabatier-Normann process. On the other hand it will give a great fillip to the cultivation of oil producing seeds and trees in the tropics.

Seeing by Wire

DEPUTY CONSUL-GENERAL CARL E. LOOP of London reports that Dr. Archibald M. Low, a London consulting engineer, claims to have discovered a novel method for transmitting light by wire, the contrivance including a transmitter, a receiver, and a connecting wire, with the transmitter a screen divided into a large number of selenium cells whose electrical resistance varies according to the light striking it. A synchronously running roller is passed over the screen and includes a number of alternating conductors and insulators, a motor driving the roller at a high speed. The invention is referred to by the inventor as a kinematographic application of common electrical principles, and while it has been tested to the equivalent of four miles, the inventor sees no reason why it should not be effective for greater distances.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

ADVERTISING MACHINE.—P. C. SCOTT, 5017 Nicholas St., Dundee, Nebr. This advertising machine is adapted for use in street cars and the like. It comprises a curtain or band having a series of advertisements on one face and a mechanism provided for moving this band in such manner that the advertisements will be displayed in sequence, each being present to view and held in fixed position for a predetermined length of time and then moved out of position, to give space to the succeeding advertisement. It contains means for reversing the direction of movement of the belt near each end of its travel.

Of General Interest.

FIREPROOF PARTITION.—M. DAWSON, 702 San Fernando Bldg., Los Angeles, Cal. Mr. Dawson's invention is a fireproof partition especially adapted for use in crowded office buildings where the space requirements are exceedingly severe, so that the partition must be made very thin, without undue sacrifice of other desirable characteristics.

LIFE PRESERVER.—D. LYMAN, Twin Falls, Idaho. This invention relates to life-saving apparatus, and more particularly to a suit to be worn in the water by those unable to swim, and is adapted to permit of unobstructed use of the limbs of the wearer and of his eyes, nose and mouth, and to exclude water from his per-

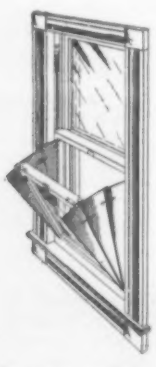
LIFE PRESERVER.

son and protect him from floating obstacles and wreckage. One or more pockets may be provided in the suit for the reception of certain necessary articles, including a bottle of fresh water, a small supply of condensed food, and a flashlamp.

SHIPPING PACKAGE.—H. THOMPSON, care of Windsor Mfg. Co., Windsor, Mo. This improvement has reference to shipping packages, and especially packages for shipping household brooms; and it has for its object the provision of a package that is reasonable in cost, efficient in preserving its contents, and simple in structure. When the package is ready for shipment it is dust- and moisture-proof, so that the brooms are fully protected.

SANITARY SHIELD.—JULIA C. KEFFER, 22 N. Raleigh Ave., Atlantic City, N. J. The shield has a receptacle for receiving discharges and means for supporting the receptacle in proper position, and for permitting the said support and means for connecting the support to the receptacle to be adjusted to fit the body of the wearer, wherein the receptacle may be easily cleaned, and wherein the receptacle is so shaped that it cannot become folded or rolled, but will always remain open and in proper shape to receive and hold all of the discharges.

VENTILATOR WINDOW.—G. B. ROBERTS, 170 E. 77th St., Manhattan, N. Y., N. Y. The object here is to provide a window sash that



VENTILATOR WINDOW.

can be used in school rooms and other public places, for the purpose of permitting the entrance into the room of a sufficient supply of fresh air and without producing a direct draft or in any other way subjecting the occupants to inconvenience, discomfort, or danger of sickness.

CARRIER OR CONVEYER.—L. HASSELBUSCH, 1026 Arch St., Philadelphia, Pa. This carrier or conveyer receives, holds, retains, and may be adjusted to any length of rod or bar made of wood or metal, and the carrier or conveyer is so constructed that, by its novel construction, a rod, bar, window shade, or map may be immediately attached to it, be retained by it, and firmly and securely held in place.

SAFETY DEVICE FOR SHIPS.—A. H. MATTHEW and JESSIE B. PROUTY, Colville, Wash. This invention relates to brake wings carried by the vessel to normally lie close against the sides thereof, and adapted to swing outward to impede the movement of the vessel. It comprises novel means for controlling the wings, to release and position them for braking action, and to fold them into inoperative positions.

HOLDER AND DELIVERER FOR DRINKING STRAWS.—R. M. REID, Colorado Springs, Col. This invention has reference more particularly to positive discharging or distributing means for the straws, whereby they are discharged singly, the device being designed to be easily manipulated by an attendant or person desiring to obtain one of the straws.

FOUNTAIN SYRINGE PRESSURE CLAMP.—M. J. RABAT, 2121 86th St., Brooklyn, N. Y. Mr. Rabat has invented a clamp which, when applied to the surface of the bag, will increase the impinging force of the stream of a suspended bag, and will create pressure on a bag not suspended, which would be very convenient during voyages, or when there is no convenient means for the suspension of the fountain syringe. The clamp is for use on fountain syringes of the flexible-bag type, and comprises two hinged plates, having resilient means, coacting with a cam associated with said plates.

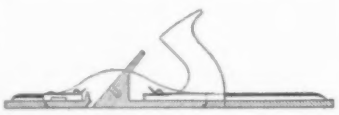
SHIPPING CRATE.—H. B. KOPP, P. O. Box 1236, New Haven, Conn. This invention relates to means for packing and shipping various articles of a perishable or breakable nature, so as to provide a separate chamber or compartment for each article, whereby it may be properly protected from contact with a rigid wall or with an adjacent article.

POCKET CLIP FOR RETAINING ARTICLES.—W. L. HOFFMAN, 5 Wayne St., Jersey City, N. J. This invention refers to article holders, and more particularly to a pocket clip for retaining articles in a pocket, although the device may be used for other purposes. It provides an extremely simple and effective article-retaining device, conveniently manipulated for applying or removing the articles, which is efficient and reliable in use.

Hardware and Tools.

NON-SHORT-CIRCUITING PICK.—N. LIPOFF, 23 Brown St., Flemington, N. J. This invention relates more particularly to picks adapted for use in electrical railroad construction or other work in which danger exists in the use of the common pick in causing short-circuiting or grounding of the current. This is obviated by a multi-part pick which embodies two sections including a point or digger and a tamper, each having sleeve portions attached to the handle in a novel manner, with insulation between the sections for the purpose of electrically separating the same.

PLANE.—J. SMITH, P. O. Box 4, Pooler, Ga. This invention relates to woodworking tools and has particular reference to the construction of carpenters' planes, whereby the tool may be adjusted or modified in size and thereby made to serve as a substitute for several different sizes of planes commonly required by



CARPENTER'S PLANE.

a carpenter. It provides a tool which is adapted, by the provision of one or more extensions, to take the place of a set of planes including a smoothing or block plane, a jack plane, a fore-plane, and a jointer.

Heating and Lighting.

PORTABLE RADIATOR HEATER.—M. LEWLESS, Brooklyn, New York, N. Y. This invention comprehends the provision of a portable radiator heater, the device being adapted to receive any improved form of radiator having suitable means for supplying water thereto, and carrying a burner for heating the water or generating steam for heating purposes.

LANTERN.—J. BARTON, J. MELBOURN, F. NEEDHAM and J. G. GREEN, Cle Elum, Wash. Address J. C. Gleysteen, care of Short & Gleysteen, same place. This invention relates more especially to lanterns of the kind used in connection with acetylene gas, the more particular purpose being to provide a construction in which the water tank and the carbid container, associated with the making of the gas, are connected together by the drop pipe, and removable as a unit for purposes of lighting the lamp.

ACETYLENE GAS GENERATOR.—A. M. SALAZAR, care of Brazilian Consul, 17 State St., New York, N. Y. This invention relates to acetylene gas generators, and has reference more particularly to gas generators for incandescent burners comprising a gas-generating chamber having means balancing the chamber pressure, and feeding means for the chamber controlled by the pressure balancing means. In the gas generator the gas pressure is balanced by a hydrostatic head controlling the feed of carbid to the gas chamber.

DRAFT REGULATOR.—A. H. MARHENKE, New York, N. Y. This invention relates to a novel draft regulator for low-pressure steam boilers, more particularly used for heating purposes, the construction being such that a delicate regulation will be automatically effected and maintained, even after prolonged use.

Machines and Mechanical Devices.

CUTTING ATTACHMENT FOR SEWING MACHINES.—G. W. PARKINSON and R. S. TOMPKINS, Beacon City, N. Y. Address Louis H. Stotesbury, 55 Liberty St., New York, N. Y. This invention provides an attachment for sewing machines, more especially designed for accurately cutting the welt on the brim of a felt hat during the time the welt is stitched in place and while a stiffening wire may be inserted in the welt.

CABLE EXCAVATOR.—A. D. HADSEL, care of Cable Excavator Co., 410 Arcade Bldg., Philadelphia, Pa. This invention relates to excavators of the aerial type and has particular reference to improved means for facilitating the loading, transporting, and dumping operations, all from a main power station at one end of the line of excavation.

RECORDER.—E. SCHUCH, 25 Giselastrasse, Munich, Bavaria, Germany. This recorder is more especially designed for use in connection with lifting machines, block presses, bending presses, forging machines, etc., and arranged to furnish a permanent record of the quality and quantity of the work and the work done by the machine and workmen, at the same time enabling the workmen to accurately apply the pressure of the machine for a predetermined period of time.

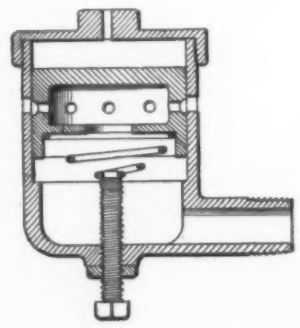
WASHBOILER.—A. GRUENSTERN, R. No. 3, Marion, Wis. The purpose in this instance is to provide a boiler wherein means is provided for cleansing clothing mechanically by the circulation of liquid holding in solution a cleansing medium. The improved mechanism may be made of any desired shape to fit any form of boiler.

LOOM ATTACHMENT.—I. COULOMBE, 53 Riverview St., Fall River, Mass. The intention here is to provide an attachment wherein the tension on the warp beam is controlled directly by the weight of the yarn on the beam, and wherein the mechanism is so arranged that as the yarn feeds from the beam, the tension will automatically decrease.

Prime Movers and Their Accessories.

ENGINE.—G. PROCHAZKA, 6610 19th Ave., Brooklyn, N. Y. More specifically this invention relates to a rotary engine having a main rotor provided with a motive fluid chamber, a secondary rotor movable with the main rotor and eccentric with respect thereto, so as to vary the capacity of the motive-fluid chamber and adapt the same for use as a compression chamber, and a turbine element adapted to receive motive fluid under compression from the motive-fluid chamber.

AIR VALVE FOR INTERNAL COMBUSTION ENGINES.—A. G. GARBUTT, Statenville, Ga. The purpose of this invention is to provide a valve to be connected with internal combustion engines and preferably mounted upon the manifold pipe of the engine for con-



AIR VALVE FOR INTERNAL COMBUSTION ENGINES.

trolling or at least modifying the air supply. The valve is made automatic in its action and controlled by the degree of vacuum obtaining in the manifold pipe so as to increase the air supply as the vacuum diminishes and to diminish the air supply as the vacuum increases.

Railways and Their Accessories.

RAILWAY TIE AND RAIL FASTENER.—H. A. BERQUIST, St. Croix Falls, Wis. This invention provides fastening means involving simple implements that will not be liable to become loose as are rail spikes of the usual form; provides a fastening means that may be quickly and conveniently applied to the rails and ties, and as readily removed when required, and provides a fastening means having the required strength to withstand the strains of use, while at the same time involving a minimum cost.

Pertaining to Recreation.

LAWN GAME.—J. NORTON, 700 E. 165th St., Bronx, N. Y., N. Y. The primary object here is accomplished in the provision of a lawn game commonly known as "Lawnette," and the same consists of a projecting apparatus having means for anchoring the same to the ground, such apparatus being pivotally mounted so as to be adjusted at different inclinations, whereby balls designed for use with the apparatus may be projected at different elevations and distances therefrom.

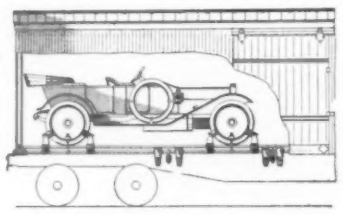
Pertaining to Vehicles.

BRAKE OPERATING DEVICE.—M. E. PUE, Marlinton, W. Va. An object here is to provide a device which will positively hold the brake in its operative position, but which may be easily moved to release the same with a minimum effort. Further, to provide a removable lever which may be taken out when the wagon is being loaded, and which may be replaced when the loading is finished, thereby facilitating the loading operation.

TRACTOR.—R. MARSH, Weldon, Ill. This invention relates to tractors, and more particularly to an improved construction of pilot or guide wheels for tractors or other machines of a similar nature. It provides a pilot wheel which may be driven by the propelling means of the machine and at the same time be turned in any direction for guiding the tractor. It also provides a pilot wheel which may be reversed.

GARAGE.—J. A. VARIAN, 76 Ward St., Norwalk, Conn. This invention provides for installing or removing cars without collisions and the like, and also for obviating the necessity of an extensive building construction which is now necessary, due to the fact that the floor spaces are left generally clear but weakened by reason of the bridging of the full width or area of the garage by floor beams, while the present invention permits of a maximum amount of storage space and weight to be supported within a predetermined area.

AUTOMOBILE ATTACHMENT.—E. F. MARTIN, Buras P. O., La. This attachment is adapted for use in freight cars, and the invention provides mechanism in connection with a railroad freight car for supporting automobiles during shipment, in such manner that the automobile is prevented from movement



AUTOMOBILE ATTACHMENT.

either longitudinally or laterally with respect to the car and is firmly clasped to the car, and wherein the mechanism is so arranged that it may be moved into or out of operative position, and beneath the level of the floor of the car, to prevent interference with other freight when the car is used for other purposes.

Designs.

DESIGN FOR AN EMBLEM OR BADGE.—G. E. NERNEY. Address The Charles M. Robins Co., Attleboro, Mass. This ornamental design comprises a heart within which is placed the head of a moose. Attached to the heart is a conventional ribbon bearing the legend "Mooseheart."

DESIGN FOR A BUTTON.—J. F. BYRNE, care of City Button Works, 374 Second Ave., New York, N. Y. In this ornamental design for a button the article is of oblong shape, and its plan view, side elevation, and end presentation show a button of attractive and graceful lines.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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INQUIRIES

Inquiry No. 9375. Wanted the name and address of the manufacturer of a separable fastener, invented especially for shoes and other articles.

Inquiry No. 9376. Wanted, the name and address of a manufacturer making clock-work mechanism for running window display machines as employed by safety razor manufacture.

Inquiry No. 9377. Wanted, the names and addresses of factories making farm implements for export.

Inquiry No. 9378. Wanted, the name and address of a manufacturer of smooth metal mirror frames, such as are sold in 5 and 10 cent stores, with a mirror and a cardboard back.

Inquiry No. 9379. Wanted, meteorites—information desired concerning available specimens.

Inquiry No. 9380. Wanted the name and address of a manufacturer of burners and handles for gas-heated sad iron.

Inquiry No. 9381. Wanted the name and address of manufacturers of vacuum adhesive hangers or other appliances for hanging cards, frames, charts, etc., to walls of buildings.

Inquiry No. 9382. Wanted the name and address of a manufacturer who can make a small or large quantity of sugar bowls with trade marks incorporated therein.

Inquiry No. 9383. Wanted the name and address of a manufacturer who can make clock movements suitable for fly trap. They must be furnished at low cost and must operate a belt for a period of from two to four hours, or more.

Inquiry No. 9384. Wanted the name and address of a Company that can manufacture a combined toothpick and toothbrush made of special wood.

Inquiry No. 9385. Wanted the names and addresses of manufacturers of machines used for perforating music rolls for automatic pianos.

Technical Schools

READERS' SERVICE—Hardly a week passes but the Editor receives letters from readers of the Scientific American who ask him whether they shall send their boys to a technical school. Whether a boy shall become an engineer, a chemist or a naval architect are questions that puzzle parents. The Editor will be pleased to aid readers of the Scientific American in deciding the matter of technical education for their sons. Address: Educational Bureau.

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Bulletin upon application to

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Measuring a Racing Yacht

(Concluded from page 100.)

place at the stern, and the sums of these distances subtracted from the overall length on the deck gives the actual load waterline. For ordinary American racing yachts the load waterline plane is established each season and permanently marked at bow and stern and on each side of the yacht near the point of greatest breadth, this plane being as nearly as possible the plane of flotation when in racing trim.

The displacement is obtained either by weighing the yacht or by a computation where the load waterline is divided into ten equal parts, and the area of the immersed cross-sections found in square feet. From these areas and the load waterline length the displacement in cubic feet is calculated by a formula known as Simpson's rule. For determining the quarter-beam length a large floating Y-shaped wood caliper is used to measure the overhang.

The draft also of a racing yacht always must be considered, as any excess over a fixed limit is penalized. This limit is taken at 16 per cent of the load waterline plus 1.75, and any excess of draft exclusive of the centerboard as obtained by this calculation is to be multiplied by 3 and added to the rating. There is no limit to the actual displacement of a yacht, according to the rules, but the cube root of the displacement factor D as used in the measurement formula must never exceed 20 per cent of the load waterline plus 0.50. If the actual displacement is smaller than that allowed by this limit, the actual displacement is used in determining the measuring, but if the actual displacement is greater, then the limiting value of the cube root of D is employed.

The measurer not only is concerned with the hull, but, as will be seen by further reference to the original formula, with the area of the sails obtained from actual measurements, both of them and of the spars. The data he must secure in such measurements will be apparent by reference to the accompanying diagram. In measuring the mainsail and topsails of sloops, schooners, and yawls and mizzen and topsails of three-masted schooners, etc., he must obtain B, the length of boom measured from after side of mast to outboard end; G, the length of gaff when lying on top of the boom, measured from the afterside of mast to outboard end; P, a perpendicular to be measured along the afterside of the mast from the top of the highest sheave in the mast or topmast, or from the juncture of the mast or topmast with the eyebolt or pennant of the highest halyard block, to the upper side of the boom when touching the upper part of the goose-neck; H, a perpendicular to be measured along the afterside of the mast from the upper side of the boom, when touching the upper part of the goose-neck, to the lower edge of a black band, at least 1 inch in width, upon the mast, above which mark the throat cringle of the mainsail shall not be hoisted; D, the diagonal, which is calculated as follows:

$$D = 0.96 \sqrt{B^2 + H^2}$$

and T, the length of the leech of the working topsail or jib-header, to be measured from the sail when dry and stretched hard taut.

The mainsail area is obtained from the above measurements by multiplying the length of bottom by the perpendicular height, and to the product adding the length of gaff multiplied by the diagonal, the sum being divided by two, expressed in a formula as follows:

$$\frac{B \times H + G \times D}{2}$$

To obtain the area of the working topsail or jib-header, the area of a triangle whose three sides are G, P—H, and T is included, while in pole-masted vessels carrying sprit topsails, the length from the highest point of the sprit to the upper point of measurement of H shall be used instead of P—H in computing the area of the topsail.

To determine the area of the headsails, the quantities required are J, the distance from the foreside of the mast to where

The Quest of Cold Light

Talks about MAZDA No. 5

"Not the name of a thing but the mark of a Service"

SWITCH on the current that causes an electric incandescent lamp to glow. What happens? You get light, but also heat. Since your eye is a special instrument particularly sensitive to light, since you read a book with light and not with heat, the more light that you get from your lamp the more satisfactory should be the result in every way. A light which is brilliant but *cold* would represent the ideal of efficiency.

Whether or not this ideal is reached, the incandescent electric lamp will grow steadily colder, steadily more efficient, thanks to the Research Laboratories of the General Electric Company at Schenectady.

In these laboratories a corps of picked men, each an expert in some phase of illumination, men who are in communication with the foremost European investigators of light, are constantly at work. After many months of patient experimenting the art of drawing tungsten into a delicate wire was developed in these laboratories. Thus it became possible to make the new filament which glows in the MAZDA lamp of today and which has supplanted the old carbon filament because three times as much light can be obtained for a given amount of current.

The Research Laboratories of the General Electric Company represent almost every branch of technical knowledge—chemistry, metallurgy, physiology, psychology, physics, microscopy, engineering, optics.

In these laboratories scientists conduct many researches along advanced theoretical lines. What is the secret of the phosphorescent glow that emanates from certain marine animals and decaying organic matter?

Why can the glow-worm shine in your hand and never burn your skin? What is the exact color of daylight? Is the best artificial light a miniature sun or a body with a brilliancy not so white? Scores of such problems must be attacked in the quest of the ideal light.

But even more important commercially is research that gives promise of immediate results. Suppose that chemists, for example, discover a way of preparing an element so that it is able to yield much light without breaking down readily under the electric current. Their discovery may mean the birth of a new lamp, or it may come to naught. It must be subjected to critical study by other scientists. The physicist steps in with his analytical instruments to discover how much of the glow that comes from the new material is light and how much is heat, in other words, how much more efficient is the new material than anything thus far discovered; he estimates what is the candle power of the new material for a measured amount of current; he devises better physical conditions for the material to perform its function. Next, the microscopist, perhaps, studies it to learn how it withstands the pitting and the scoring action of the current.

Thus the new material is passed through successive laboratories, from scientist to scientist, from engineer to engineer. If the discovery proves to be of commercial importance the General Electric Company transmits it to its own lamp manufacturing centers at Cleveland and Harrison and to other companies entitled to learn of it.

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the foremost edge of the sail cuts the bowsprit, and P_2, a perpendicular measured along the forward side of the mast from the top of the highest sheave to the deck. The spinnaker boom is measured when in position, and at right angles to the center line of the boat from its outboard end to the center of the mast, and this length in yachts over 31 feet rating is limited to base J of the fore-triangle, and in yachts 31 feet rating and under by 40 per cent of the entire base line determined by the sum of B plus J plus the diameter of the mast at the boom goose-neck in the case of single-masted yachts. Any excess in length of the spinnaker boom over the above limits must be added to the base J of the fore-triangle when computing the area of the headsails. The area of the headsails is determined by multiplying the base of the fore-triangle J by the perpendicular altitude P_2, dividing the product by 2 and taking 85 per cent of the result. The total area for the use in the measurement formula is obtained by adding the area of the mainsails, topsails, and headsails; certain modifications applying to yawls and schooners. The excess of area of a club-sail over that of the working topsail is not considered unless it exceeds 150 per cent of the area of the latter.

Rating as obtained by the measurement formula not only gives the classifications of the yacht and indicates the class in which it is entitled to race, but also furnishes a basis for computing the time allowance. The time allowance depends upon the fundamental assumption that a yacht of rating measurement R will sail one nautical mile in the number of seconds given by the formula:

$$\frac{2160}{\sqrt{R}} + 183.62$$

Accordingly, the allowance per mile between yachts of different ratings r and R will be given by the formula

$$\frac{2160}{\sqrt{r}} - \frac{2160}{\sqrt{R}}$$

From this, there has been worked out an elaborate series of tables which indicate the amount of time allowance that one yacht shall give to another based on the rating in feet and decimals of feet.

The theory of yacht rating and measurement is to secure absolute equality between vessels of different sizes and to encourage the best possible design which supplies serviceable and seaworthy boats rather than racing machines.

When there comes an important series of competitions, such as those for the "America" cup, the fundamental rules of rating and measurement obtain a new importance, and while they may be modified as regards changing the trim during the season of racing, and in other minor respects, yet they apply essentially as outlined above.

New Facts About Parasites

ZOOLOGISTS have often called attention to the fact that similar animals have parasites of neighboring species, and that the resemblance of parasites can be concluded from resemblance of the animals upon which they live, a well-known example being that of the anthropoids and man. M. Fischer, professor of botany at the Berne University, shows that the same relation is true for the case of plants. Correct results, however, are obtained by observing what can be called the true parasites, for animals as well as plants, these being the ones that never leave the specimens, and which are adapted to special conditions of life. Among the vegetable parasites, the spores known as Urédinés follow this rule, and they have never been cultivated with success except upon the particular plant which harbors them. He shows that on one hand the forms which are related to the Urédinés live almost exclusively upon the representatives of the same family, and on the other that species resembling this group (Urédinés) live only on closely-related plants of the same genus or species. Thus the parasite forms of the genus *Ravenelia* live upon leguminous plants, with few exceptions. Nearly all the species of the genus *Gymno sporangium* live upon the conifers and the *Rosaceæ*. Several species of the genus Puccinia all live upon the Compósées. One of them, the *Puccinia Hieracii*, even shows a marked specialization, and has two forms, one of which lives upon the Hieracium of the subgenus Pilosella and the other upon those of the sub-genus *Euhieracium*. Other cases might be noted, and show a marked specialization. But it does not always follow that each time the parasites resemble each other the same is true for the harboring specimens, and his researches show some wide divergences which lead us to avoid making this a too general rule.

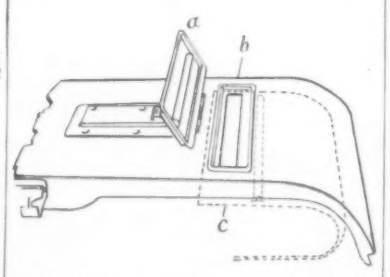
How I Came to Invent the Autographic Kodak

(Concluded from page 101.)

The actual mechanical part, that is, the small door giving access to the film, was comparatively easy, but the paper covering for the film kept me pretty earnestly employed for almost three years.

It was necessary to find a coating for the paper which could be completely shoved out of the way as the stylus passed through, giving a free access to the light. I may say that experts said it could not be done, but I persisted and eventually discovered a waxy compound impervious to moisture or to climatic influences, with which to coat my paper.

The invention was then ready to offer to Mr. Eastman. Mr. Eastman saw the possibilities of it at once, and he requested time in which to have a search made, not only in the United States, but in Germany, France, and England as well. This was necessary in order to demonstrate that



The door *a* normally covers the slot *b*, through which the writing is done. In order to provide a firm support, the camera frame *c* is utilized, part of which frame constitutes a table. The film passes over a roller and over this frame (table). The door *a* is held by a slidable latch. By pushing the latch back the door springs open. In a slot formed in the door a steel stylus is lodged, the latch holding it in place when the door is closed. When the latch is pushed back and the door flies open, the stylus drops out ready for use.

no patent had been taken out on a like invention.

After a most exhaustive search the experts in the Patent Offices in all four countries admitted that the patent was a basic one. I should like to say that during this long period of waiting Mr. Eastman's attitude toward me was that of friendship and of solicitation that I receive the full reward for my invention. In fact, I cannot make it too plain that Mr. Eastman's attitude throughout the entire transaction was of the greatest courtesy toward myself.

Mr. Eastman and I had a long talk after it had been settled that the Eastman Kodak Company was to take over the invention, and the suggestion was made that I accept a royalty. This was perfectly agreeable to me, but later on circumstances arose which made it desirable that the Eastman Kodak Company possess exclusive rights to the patent. Mr. Eastman thereupon offered me $300,000 for my rights in the patent. I considered the matter carefully, and two days later received a check for the amount.

I am, of course, glad to have $300,000. What man is not? I am also glad that the entire matter is adjusted so that I can turn my mind to new inventions, but I can truthfully say that ahead of the financial gain is the memory of the friendship, courtesy and good will of Mr. George Eastman. From the first he aided me in every way possible, and in my heart I think he was more than just.

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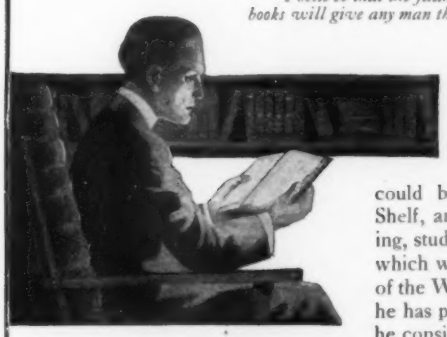

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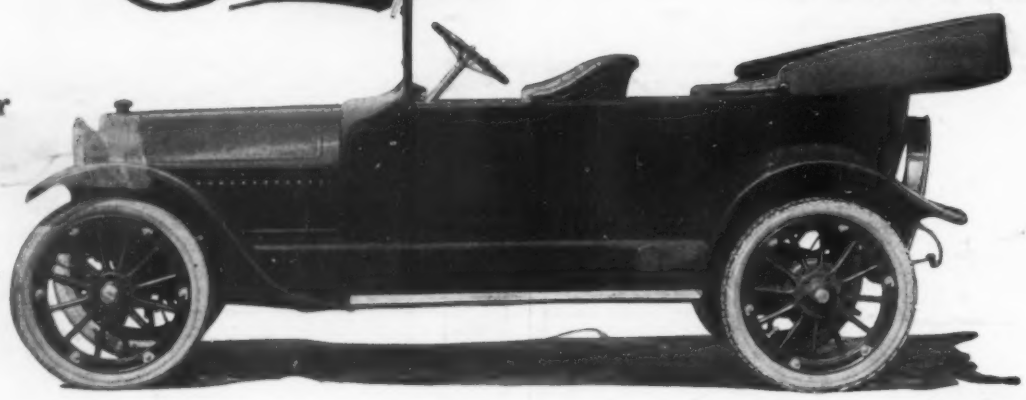

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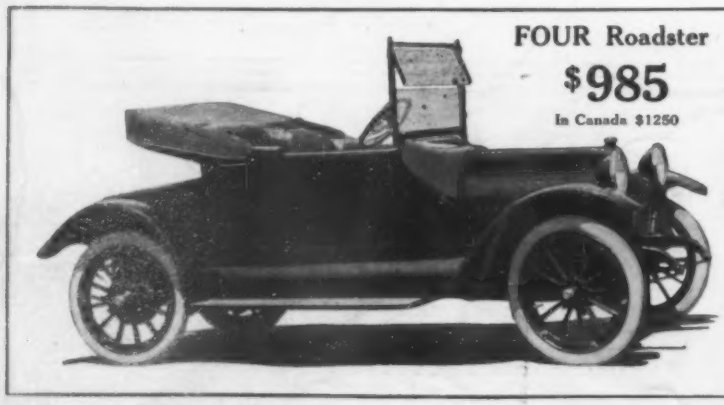
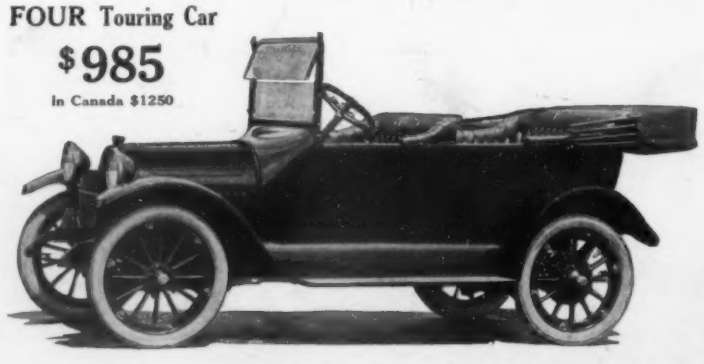
Lightened Clutch Operation.
150 Pounds Lighter.
15 x 2½ in. Brakes.
34 x 4 in. Goodrich Tires on Q. D. Demountable Rims; Safety Tread on Rear.
Roomier Front Compartment; Roomier Rear Compartment.
Continuous Aluminum Footboard.
One-Man Type Top.
Built-in Rain and Clear Vision Ventilating Windshield; Attaching Rigidly to Top.
Scientific Anti-Rumble Gasoline Tank in Cowl.
Magnetic, Non-Leaking Gasoline Gauge, the Only One Approved by Insurance Underwriters.
Full Floating Rear Axle, Shaft Locking into Taper at Hub.
Full Equipment of 13 Timken Roller Bearings.
Uniform Caps on all Four Hubs.
Irreversible Steering.
Removable Instrument Board.
Inter-Locking Ignition and Lighting Switches.
24 Finishing Operations in Painting Bodies Studebaker Blue.

FOUR Roadster
$985
In Canada $1250



FOUR Touring Car
$985
In Canada $1250